Reducing Stress in Schools

Information for Principals, Teachers and Parents About Stressed Children in Disaster-Struck Communities and How to Help Them in Difficult Times

Kathleen Liberty

School of Health Sciences

College of Education, Health and Human Development

University of Cantebury

Christchurch, New Zealand

Credits

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Reducing Stress in Schools

Dedication

To Maureen Allan, Manager, Resource Teachers of Learning and Behaviour, Te Paoroa Cluster, Christchurch, New Zealand.

Without Maureen, none of this would have happened, and without her encouragement, the strategies would never have been trialled.

To the Principals and Teachers of the Strategy Schools, and to all the children lucky enough to attend them.

Introduction

The Juniors Settling In and Learning in Primary School Study ("Juniors Study") began in 2013 and involved five schools in East and South Christchurch. This book is an outgrowth of this project.

Following the earthquakes in Canterbury, a senior manager in the school support services, Maureen Allan, heard from teachers about difficulties and challenges in teaching children entering school for the first time in 2012. Subsequently, Maureen and I realised that it would be possible to determine if the children who were starting school at five years of age in 2012, after experiencing the incredible period of more than 15,000 earthquakes, were actually in some way different to children – also five years old-- who entered school years before the earthquakes began.

This comparison was made possible because of a study conducted in 2006-2008, with final data collection early in 2009. This previous research study was funded by the Asthma Foundation of New Zealand to evaluate the health effects of asthma and other conditions on children's learning. There were eight randomly schools in this study, and six of these schools

were, by chance, in the East and South areas of Christchurch, the areas most affected by the earthquakes that occurred four to five years after the conclusion of the study. This study would be an excellent comparison to evaluate the effects on children of the earthquakes and post-earthquake events.

Maureen and I used a bare-bones approach to collecting comparative information about children who were younger than 42 months on 4 September 2010—the date of the first major earthquake in the long sequence of earthquakes this region is still experiencing. All of the schools in the Te Paeroa school cluster were invited to participate via email, in September 2012. Unfortunately, this recruitment was negatively impacted by the Ministry of Education's announcement during the same week to close some schools, reorganise or merge other schools, and make additional changes (including schools in the baseline study). Five schools volunteered to participate in the study despite the ongoing challenges. These schools are all in the East and South parts of Christchurch.

The Juniors Settling In and Learning Study received consent for its procedures from the University of Canterbury Human Ethics Committee in 2012 and began recruiting participants in 2013 and completed recruiting participants in term 4 2015. The children in that study were born between 2007 and 2010. Study children were present for the major earthquakes and had lived in Christchurch from 4 September 2010 through to their school start.

The same teacher report measures of children's positive and concerning behaviour were used in earthquake study and the pre-earthquake study. Using the same measures produced meaningful comparisons between the baseline group and the earthquake-exposed group at the beginning of the project, and these comparisons are described in this book.

These children have continued in the project, with teachers completing the same type of report twice a year, at the beginning and end of each school year. Parents have been active study members, receiving information and updates twice a year, and providing information on children's exposure to stressful events during the earthquake period, their physical health, and positive behaviours at home.

The data collected here in Christchurch have been evaluated using research published in peer-reviewed journals and books. Intensive reviews of the scientific literature were conducted over the past two and a half years, concentrating on the effects of disasters on children and their families, and how schools could best respond. The causes, symptoms, and developmental course of post-traumatic stress disorder and the biological effects of extended

traumatic stress on the development, mental health and learning of children were also studied. And finally, evidence related to the treatment of post-traumatic stress disorder was considered. Information from the literature review appears throughout this book.

The experiences of the Christchurch communities have been a critical source of information. Studies and news reports of the Canterbury earthquakes and their impacts have been crucial in understanding the impact of this disaster on the children and their families. It is important not to lose sight of the magnitude of the effects of the earthquakes, particularly even focusing on the magnitude 6.3 earthquake on 22 February 2011. These effects make this disaster somewhat comparable to other famous disasters. For example, Hurricane Katrina, which has been an important source of research on the effects of disasters, and the earthquake in Japan that occurred just shortly after the February 2011 earthquake.

Table i.1: Some Comparisons of Selected Disasters[1]

Disaster	**Population**	**Injuries**	**Deaths**	**Pre-Disaster Poverty Levels**
Hurricane Katrina	5.8 million	5698 9.8 per 10,000	1836 3.1 per 10,000	20.7% of population 30% of children (Affected area)
Canterbury Earthquakes	440,000	6,600 150 per 10,000	185 4.2 per 10,000	15% of families 22% of children (Affected area)
Tōhoku Japan Earthquake & Tsunami	1,585,900	27, 074 170.7 per 10,000	18,500-20,000 126.1 per 10,000	16% of the population 14.7% children (national data)

The table above shows some comparisons between the Christchurch earthquake, Hurricane Katrina and the Tōhoku Japanese earthquake. Hurricane Katrina is important because of the numerous studies of the effects of this natural disaster on children. The Tōhoku Japanese earthquake and tsunami is important because it occurred in a well-resourced and developed community, but was not centred under a major city, but offshore. The Tōhoku Japanese earthquake also resulted in a tsunami, and that was the primary cause of death and destruction, which makes this a different type of event to the earthquake events experienced in Christchurch. As shown in Table i.1, the Canterbury earthquakes had a higher rate of

[1] Sources for the information in this table are listed at the end of the References.

injuries and death than Hurricane Katrina, but of course much less than that experienced in Japan.

The reviews also identified the limitations of the scientific literature. First, there is no substantive research on earthquakes in communities similar to ours. Most research on earthquakes takes place in countries such as Turkey, or in China, in which the resourcing, community structure, the cultural affiliations, and the schooling and curriculum are quite different to Christchurch, New Zealand. There is also no longitudinal study of children who experienced a disaster when they were younger than four years of age, which equates to the children in the ongoing Juniors Study. Also, it is important to note that, since many studies of disasters are from the United States of America, that in the USA children start their first year of primary school at about age seven years, and at five and six years of age, children are in preschool and kindergarten. Therefore, this impacts on the interpretation and application of studies from the USA on the Christchurch context.

Although there are no studies that match this community's earthquake situation and the age of the children, there are many studies about treatments for children who experienced other forms of trauma and developed post-traumatic stress symptoms or post-traumatic stress disorder. The most effective interventions are multi-session trauma-focused cognitive-behaviour therapy delivered by trained psychologists to individuals or small groups. These therapeutic sessions have been studied intensively for children who have experienced single traumatic events (e.g., the death of a parent, maltreatment), and also within the context of natural disasters, such as a flooding. However, in post-disaster communities, there are typically insufficient resources, such as the presence of highly trained professionals, to deliver the mental health treatments needed by large numbers of the population.

The fact that this earthquake situation was so different, and that the post-disaster phase has included floods and a bushfire, and the literature is so limited means that there were no guideposts. Against this, the investigation of the changing situations in the Strategy Schools eventuated in the strategies that appear in this book. However, without the courage of the Strategy Schools in taking a chance on the strategies, the work would have remained, like so many other research projects, buried in on-line journals or technical reports. It is the Strategy Schools that have made the project live.

Chapter 1
Childhood Adversities, Trauma and Post-traumatic Stress Disorder

An idealistic picture of childhood is of endless sunny days of play in an idyllic garden setting with a loving, happy family. However, as many have experienced, actual childhoods always differ from the imagined ideal.

Research has shown that childhood experiences shape adult lives, and, more recently, that adverse events during childhood can have lifelong consequences. Findings from an landmark longitudinal study have forever destroyed the wish that children can endlessly bounce back from negative events: The Adverse Childhood Experiences Study (ACE)[2]. Researchers from the Centers for Disease Control and Prevention in the US and Kaiser Permanente Health Care conducted this study, under the leadership of Vincent Felitti and Robert Anda (1998). The first set of participants in AEC was recruited beginning in1995 and the second in 1997, with more than 17,000 adult participants. This study involved a complete medical history completed at a clinic and a questionnaire about nine childhood experiences that already had a substantial research base. These nine adverse experiences were:

- Physical abuse
- Sexual abuse
- Emotional or psychological abuse
- Mother treated violently
- Household substance abuse
- Household mental illness
- Incarcerated household member
- Parental separation or divorce
- Physical neglect
- Emotional neglect

The first of more than 50 research reports were published in May 1998 (Dube et al., 2001; Felitti et al., 1998). Although these participants were representative of a chiefly white,

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[2] More information about the ACE studies can be found easily on the internet, using, for example, Google or Wikipedia. https://en.wikipedia.org/wiki/Adverse_Childhood_Experiences_Study

educated group that was mostly employed and had health care, the results were startling. Overall, the ACE has reported that adverse childhood events are common: For instance, more than 28% reported experiencing physical abuse and more than 20% experiencing sexual abuse, and more than 25% grew up in a household in which at least one member abused drugs or alcohol.

But the most important finding of the ACE studies was the relationship between the number of adverse experiences and adult health outcomes. More than half of all adult participants reporting at least one of these adverse experiences in childhood and 40% reported experiencing two or more. The more adverse experiences reported, the higher the risk for negative health outcomes including depression, alcoholism, obesity, cancer, heart disease, stroke, diabetes, suicide and early death. These results have been confirmed in hundreds of studies.

Children's Adverse Experiences

An Australian foundation has reported that one out of every three or four children has experienced an adverse childhood event (Australian Childhood Foundation, 2010). An Adverse Childhood Event Study conducted in Washington State included 2100 randomly selected children from ten primary schools in kindergarten through grade six (about ages 6-12 years). The adverse experiences Stevens (2012) included were:

1. Being taken into care or involvement with child protective services
2. Homelessness
3. Witnessing domestic violence
4. Mental illness in the household
5. Neglect
6. Divorce

This study showed a relationship between experiencing **three or more adverse experiences** and frequent absence from school (6 times more likely), academic failure (3 times more likely), and high behaviour problems (6 times more likely). One report described the impact on the childhood of children who experience three or more adverse events this way:

> The link between childhood trauma and adult onset of chronic disease was the damage that the toxic stress of chronic and severe trauma inflicts on a child's developing brain. It essentially stunts the growth of some parts of the brain, and results in fried circuits in others. Children with toxic stress live their lives in fight, flight or fright mode – unable to concentrate to learn, responding to the world as a place of constant danger, not trusting adults and unable to develop healthy relationships with peers. Failure, despair, blame, shame and frustration follow, and children transition into adulthood finding comfort by overindulging in food, alcohol, tobacco (nicotine is an anti-depressant), drugs (methamphetamines are anti-depressants), work, high-risk sports, a plethora of sexual partners….anything to pump up feel-good moments to escape bad memories and feelings.
>
> – *Jane E. Stevens*, 2012.

The ACE study has resulted in a new impetus to research into the effects of stress and trauma. An online version of the ACE questionnaire is available at the link shown below.[3]

Traumatic Events

How do traumatic events differ from adverse events? One definition has to do with whether or not "trauma" is the outcome of an event:

> "*Trauma results from an event, series of events, or set of circumstances that is experienced by an individual as physically or emotionally harmful or threatening and that has lasting adverse effects on the individual's functioning and physical, social, emotional, or spiritual well-being.*" (Trauma-Informed Care in Behavioral Health Services, 2014).

Other studies have identified events as traumatic if they are associated with a high risk of causing mental disorders associated with traumatic stress, such as post-traumatic stress disorder. For instance, the *Child PTSD Checklist* (Scheeringa, 2012) for children aged 1-6 years includes the following criterion.

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[3] http://www.npr.org/sections/health-shots/2015/03/02/387007941/take-the-ace-quiz-and-learn-what-it-does-and-doesnt-mean

"Events must have been witnessed by the child, and led to serious injury to the child or another person, usually someone the child loves, or be perceived by the child as if it could have led to serious injury."

- Accident or crash (automobile, boat, plane)
- Attacked by an animal
- Human-made disasters (war, terrorism)
- Natural disasters (hurricane, flood, tornado)
- Hospitalization or invasive medical procedures
- Physical abuse
- Sexual abuse, sexual assault or rape
- Accidental burning
- Near drowning
- Witnessed another person being beaten, raped, threatened with serious harm, shot at, seriously wounded, or killed
- Kidnapped

An Australian study (Slee, 1993) has identified life events that are associated with adverse effects on children's adjustment to school. These include adverse events included in the ACE study, as well as other 'typical life events' that have not usually been identified as adverse, such as the birth of another child in the family. Such events may increase stress in the family and affect the school-aged child. The events included in the scale developed by Slee (1993) shown on the next page.

Some events appear in lists of both "adverse" and "traumatic", such as sexual abuse. One of the considerations in classifying events is based on how an individual reacts in the immediate aftermath of the event, and how the event affects an individual in the longer term. The rapid increase in studies about stress, stressors, and the impact of stress is constantly improving the understanding of the impact of adverse and traumatic events (Trauma-Informed Care in Behavioral Health Services. Rockville (MD): https://www.ncbi.nlm.nih.gov/books/NBK207191/).

The ACE study has also been placed within the context of epidemiological studies of risk, including.

- Chronic Poverty
- Experiences of racism

- Historical and intergenerational trauma

The wider context of risk also includes events such as childhood poverty, because of the clustering of adverse events in poverty-stricken households, and the additional stressors such as food insecurity. Chronic poverty in the US is significantly associated with poor brain development, and the experience of stressful life events appears to add to this (Luby et al., 2013). Experiences of racism, or unfair treatment perceived to be based on ethnicity, is also associated with higher risk of mental and physical health problems, in the US and New Zealand (Harris et al., 2012). Historical trauma, such as that associated with colonisation and subjugation, is also associated with biological changes across generations as intergenerational transmission of stress (Bowers & Yehuda, 2016; Heim & Binder, 2013; O'Neill et al., 2016).

However, the classification of individual events as "adverse" or "traumatic" is not essential to understanding that such events impact on children, families, school and communities.

Potential Sources of Child Stress (Slee, 1993)

1. Another child has been born into the family.
2. The family has moved several times.
3. Conflict among family members has increased.
4. A child in the family has been hospitalised.
5. There has been a death in the family.
6. The family has faced greater than usual financial problems.
7. A parent has been in an accident and hospitalised.
8. Parents have separated/divorced.
9. A parent has been unemployed.
10. Parents have divorced.
11. The family home has been broken into.
12. The family has had psychological counselling.
13. Other people have moved into the family home.
14. A parent is away from home frequently.
15. There has been less marital harmony.
16. A family member has been robbed/attacked.
17. A child in the family has had psychological counselling.
18. Parents have changed jobs.
19. The family has used social welfare resources.

20. There has been a serious illness in the family.
21. There have been consistent discipline problems with one or more of the children.
22. Parent(s) have had a major change in responsibilities at work
23. The child has been hospitalised.

From: Parent Life Events Survey available: *http://www.caper.com.au/pages/adultsurv.htm*

Traumatic Events and Post-traumatic Stress

Traumatic events can lead to the development of mental health problems, and the most likely outcome is the development of Post-Traumatic Stress Disorder (PTSD), with odds of 27.2 (Kessler et al., 2014). Post-traumatic Stress Disorder (PTSD) is a specific psychiatric-defined mental health condition meeting internationally accepted diagnostic criteria with disabling impairments (Karam, Friedman, Hill, Kessler et al., 2013). However, other mental health disorders that have increased risk due to experiencing traumatic events include social phobia, social anxiety disorder, ADHD (1.6-1.7 increased odds), separation anxiety disorder (1.7 to 2.0 increased odds), and generalised anxiety disorder (2.2-2.5 increased odds).

PTSD in adulthood is associated with severe impairment in work, home maintenance, relationships and social life. Even the presence of Post-traumatic Stress Symptoms (PTSS) which are not necessarily perfectly matched to the diagnostic criteria for PTSD, has a high odds ratio of producing clinically significant distress and impairment, as well as suicidality (Karam et al., 2013; McLaughlin, Koene, Friedman, Ruscio et al., 2014). However, adults with PTSD may not perceive themselves as having a psychiatric disorder, and may not seek psychiatric treatment (Crocq, 2002).

Studies have identified predictors of whether an individual will develop PTSD following a traumatic experience (Goldmann & Galea, 2014; Kessler et al., 2014).

- The first predictor is the type of the traumatic event, with physical or sexual assault the strongest predictor.
- A second predictor is the severity and/or duration of the event, with events that are severe and/or long-lasting associated with increased risk as compared with events that are more short term or less severe.
- A third predictor is female gender.

- Fourth, younger children are more likely to develop PTSD as compared to older children.
- The fifth predictor is the number of prior traumatic events to which the individual has been exposed, with the greater the number of events, the greater the risk of subsequent PTSD.
- The sixth risk factor is a prior history of mental health problems including anxiety and depression.
- Seventh, the severity of the biological and emotional responses to the traumatic event, and
- Eighth, experiencing heightened life stress and/or low social support in the days and weeks after the traumatic event.

New Zealand has the world's third highest 12-month prevalence of PTSD among adults, according to the World Health Organisation's study of 20 high-, mid- and low- income countries (Karam et al., 2013). New Zealand (NZ) mental health surveys identify a lifetime prevalence of PTSD of 6.0% (Wells, 2009). Onset is associated with the experience of a serious traumatic event, abuse in childhood, life-threatening accidents, war, terrorism or natural disasters (Alisic, Zalta, van Wesel, Larsen et al., 2014; Connor, Ford, Amsten & Green, 2014; Hornor, 2013).

PTSD in Children

PTSD in children is associated with poorer physical health, comorbid mental health problems, suicide ideation and substance abuse, as well as increased school absences, poor learning, memory and achievement, and impaired relationships with parents, siblings, peers and teachers (Breslau, 2009; Chu & Lieberman, 2010; Fairbank & Fairbank, 2009).

Children who have post-traumatic stress symptoms (PTSS) or who are diagnosed with PTSD are at increased risk of lower school achievement and mental health problems in adulthood. Child PTS symptoms and PTSD are also associated with poorer physical health, comorbid mental health problems in childhood, suicide ideation and substance abuse, as well as increased school absences, poor learning, memory and achievement, and impaired relationships with parents, siblings, peers and teachers (Chu & Lieberman, 2010; Scheeringa, 2014; Shaw, Espinel & Schultz, 2012).

Risk factors for the onset of PTSD in children who have experienced traumatic events consistently include female gender, minority ethnicity and low socioeconomic status (SES),

parent mental health, pre-existing mental health problems as well as the type, intensity, and duration of the traumatic event/s (Alisic et al., 2014; Contractor, Layne, Steinberg Ostrowski et al., 2013; Shaw, Espinel & Schultz, 2012).

Studies indicate that PTSD arising in early childhood is likely to persist (Chu & Lieberman, 2010; Scheeringa, 2008).

Finally, PTSD is associated with changes to structures in the brain, notably the amygdala, hippocampus and prefrontal cortex (Blair & Raver, 2012; De Bellis & Zisk, 2014).

Diagnosis of Child PTSD

In 2013, the American Psychiatric Association (2013) published new criteria for the diagnosis of post-traumatic stress disorder (PTSD). PTSD was removed from the classification of anxiety and mood-disorders and re-categorized within a new category of stress-related disorders. Also, criteria were identified that differentiated and described young children's symptoms as different to adult symptoms, recognizing the developmental differences in symptoms expression. However, PTSD is also not recognized in the New Zealand and Australian guidelines for the diagnosis and treatment of mood disorders (Mahli et al., 2015).

PTSD is very difficult to diagnose in very young children because the children are too young to have sufficiently developed the language to communicate their feelings, and may not recognise or be able to communicate concepts such as feeling nausea or stress. Additionally, because their facial affect is different to older children, interpretation of mood is difficult. Also, because the children are not able to fully understand the actual nature of the disaster, and because young children do not understand chance events, children may have false beliefs and attributions about the relationship between their behaviour and disaster-related events. Finally, because children may express their feelings through disorganised and difficult behaviours, which create misunderstandings and misattributions in their parents and teachers, as well as affect the reliability of parent-reported mental health diagnostic processes (Shaw, Espinel & Schultz, 2012; Takada, 2013).

Measuring the number of symptoms in children against a cut-off point is used to define PTSS in many research studies, due to the difficulties of diagnostic protocols and processes in diagnosing young children against specific PTSD criteria, particularly in post-disaster situations, when so many children are affected at the same point in time (Fairbank & Fairbank, 2009; Feo, Di Gioia, Carloni, Vitiello, Tozzi & Vicari, 2014; Loeb, Stettler, Gavla, Stein & Chinitz, 2011; Shaw, Espinel & Schultz, 2012).

Fifteen or more different symptoms of PTSD in children have been identified, including irritability, anger outbursts, fear, anxiety, impulsivity, social withdrawal, sadness, difficulty concentrating and sudden mood changes (American Psychiatric Association, 2013; Chu & Lieberman, 2010; Fairbank & Fairbank, 2009; Shaw, Espinel & Schultz, 2012; Scheeringa, Zeanah & Cohen, 2011).

Prevalence of Childhood PTSD

Baseline rates of preschool PTSD have been shown to be very dependent on how young children's behaviour is interpreted by parents, teachers and specialists, as well as on the specific criteria and procedures required for a diagnosis, as well as the time interval that has elapsed since the trauma at which PTSD is assessed (Scheeringa, 2008; Scheeringa, Zeanah, Myers & Putnam, 2003).

However, it is difficult to estimate the prevalence in young children, due to the change in criteria. In a comparison of old and proposed criteria, ten percent of children aged 2-4 years had PTSD six months after a traumatic motor vehicle accident (Meiser-Stedman, Smith, Glucksman, Yule & Dagleish, 2008). A meta-analysis of 72 studies, excluding PTSD from natural disasters, identified an overall rate of PTSD of 15.9% in children (Alisic, et al., 2014), but only two studies included children aged six years or younger. PTSD in young children following natural disasters may be higher, due to the expanded effects on the ecological context, as discussed in the next chapter.

PTSD Impacts the Developing Brain

Post-traumatic stress can produce negative impacts on children's brains and development.[4] In particular, the autonomic nervous system and the amygdala are impacted.

Exposure to prolonged stress can disrupt the development of the brain and neurological systems of young children (Harvard Center on the Developing Child, 2006). According to the scientific literature and DSM-5 criteria, PTS symptoms also are associated with their bodily health in the form of somatic symptoms of stress. There is overwhelming evidence from the

[4] Bergland, C. (2014). *Chronic Stress Can Damage Brain Structure and Connectivity***.** An easy to understand article about PTSD and brain changes from Psychology Today website. https://www.psychologytoday.com/blog/the-athletes-way/201402/chronic-stress-can-damage-brain-structure-and-connectivity

biological psychiatric literature that the Autonomic Nervous System is dysregulated by PTSD (Gupta, 2013; Rees, 2014).

The term 'autonomic' is derived from the word 'autonomy' and in neurophysiology refers to autonomous, self-governing aspects of the nervous system that are beyond conscious control (Todman, 2008). The somatic nerves of the peripheral nervous system convey information from the eyes, mouth, nose, skin, muscles and other organs, through the ganglia to the ANS.

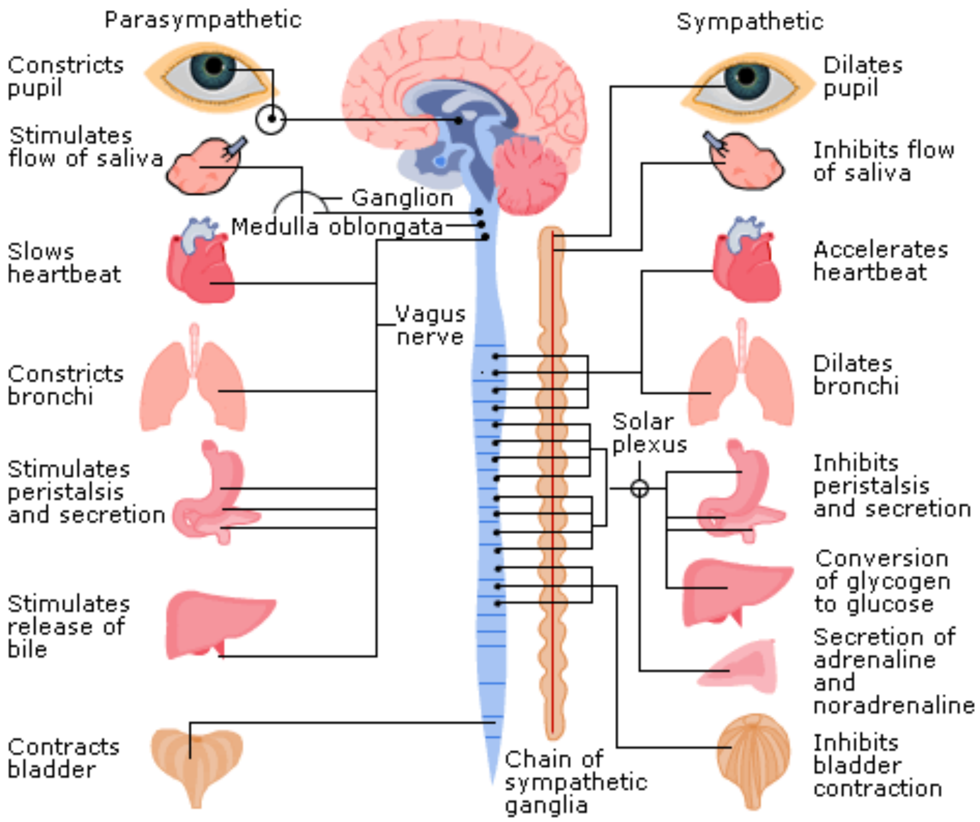

Figure 1.1 Some of the functions of the Autonomic Nervous System, including functions disrupted by PTSD.[5]

The ANS is comprised of the sympathetic nervous system, which generally regulates stress reactions involving increased breathing, heart rate, and stress hormone production; and the parasympathetic nervous system which is associated with the calming and restoration of functions following stress, such as decreased breathing and heart rate (Beauchaine, 2012; LeDoux 2003; 2012; Rees, 2014). The hypothalamic–pituitary–adrenal axis, which helps the

[5] This diagram is from a freely-available resource created by the Royal College of Anaesthetists of Great Britain and Ireland. http://www.e-safe-anaesthesia.org/; http://www.e-safe-anaesthesia.org/sessions/15_05/d/ANAE_Session/377/tab_494.html

autonomic nervous system calm down by signalling hormone production, is also dysregulated by PTSD.

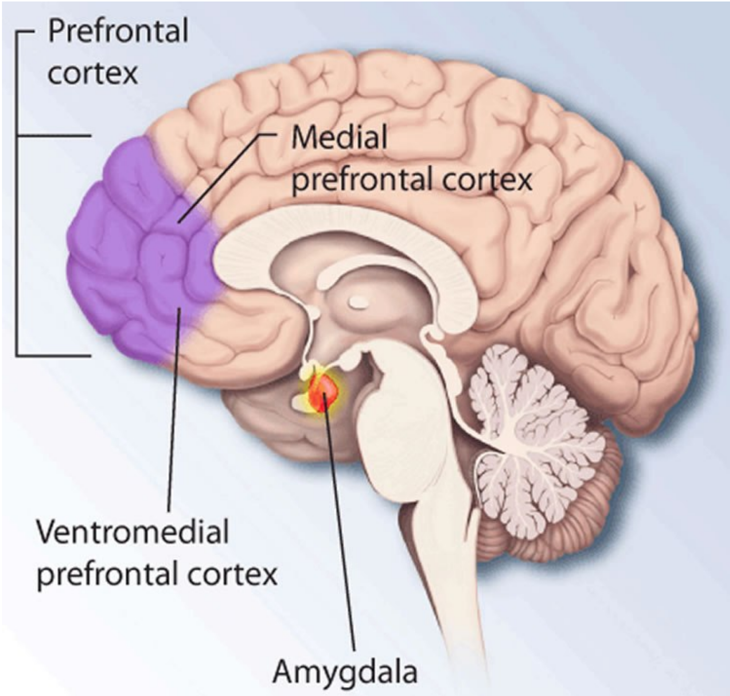

Figure 1.2. Areas of the brain associated with aspects of emotional control, including those areas dysregulated by PTSD.Image from the National Institutes of Mental Health asserted in the public domain. http://neurosciencenews.com/fear-amygdala-prefrontal-cortex-oscillations-3699/

The amygdala is critically involved in emotions and emotion regulation, emotion-related behaviours and language, anxiety, fear, aggression, motivation, attention, concentration, reward and implicit memory (Bennett, Hatton & Lagopoulos, 2015; LeDoux, 2002; 2012; Tottenham & Sheridan, 2010). The amygdala receives sensory information directly from the peripheral nervous system and then coordinates automatic reactions to the sensory information, including interacting with the hypothalamic-pituitary-adrenal axis, which directs the neuroendocrine responses to fear. The amygdala also receives information from the prefrontal cortex and higher-order parts of the cortex. The prefrontal cortex is metaphorically thought to exert downward control over the ANS and affective responses, (Arnsten et al., 2015; McCorry, 2015), while the amygdala moderates the hippocampus (Tottenham & Sheridan, 2010).

The amygdala is associated with classical and operant conditioning paradigms, including instrumental and associative learning, affecting stimulus recognition and discrimination, the specific physiological characteristics of the unconditioned and conditioned responses, the valence of the rewards, and reward-linked decision making, such as response inhibition (Davidson, 2006). The most studied aspect of this system is the recognition of threat and the reaction to fear and trauma (Cardinal et al., 2002; Corrigan & Hull, 2015b; Levenson, 2014; Morrison & Salzman, 2010; Rees, 2014).

Stress-related dysregulation of the ANS has been extensively studied for more than twenty-five years (De Bellis & Zisk, 2014; Rees, 2014). The amygdala is typically over-reactive, and the pre-frontal cortex shows less reactivity in PTSD (Thomaes, Dorrepall, Draijer, Jansma, Veltman & Balkom, 2014). This translates into responses in which the emotional, immediate and automatic occurs faster and stronger than the cognitive functions can execute actions to inhibit or control – the react before thinking situation. These changes in the amygdala and hippocampus are revealed in children's behaviour problems (Hanson et al., 2015).

> "Fear response to traumatic or threatening situations helps us evade or escape danger. At the same time, fear response is learned in the form of association between stimulus or situation and the presence of a stressor (e.g. physical danger). This association is very powerful and leaves a memory trace that *persists for years after a single experience*, generating profound structural and functional changes in the brain that can potentially develop into posttraumatic stress and other anxiety related disorders."
> ***Neuroscience News, 20 February 2016***[6]

About 65% of children who have been traumatised exhibit symptoms involving dysregulation of the ANS, including changes in blood pressure, breathing, and gastrointestinal activity (Gaskill & Perry, 2014). Considering the dysfunction of the ANS is crucial in understanding the neural basis for PTSD (Corrigan & Hull, 2015b; Zoladz & Diamond, 2013).

The neural basis of PTSD involves the dysregulation of the autonomic nervous system, and this is represented not only in the behavioural symptoms of affected children but also in the somatic or body-stress symptoms, such as sleep disturbances, nightmares, stomach aches, headaches, dizziness, high blood pressure and other physical representations (Agorastos,

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[6] http://neurosciencenews.com/fear-amygdala-prefrontal-cortex-oscillations-3699/

2017). The total impact of PTSD reaches far beyond observed behaviours and feelings of being stressed, and it is this impact that affects the results of current treatments.

Treatment of Childhood PTSD

The most effective treatment for children with PTSD is individual or small-group trauma-focused cognitive behaviour therapy (CBT), and this is most suitable once children have reached the ages of 10-12 (Barrett et al., 2006; Smith et al., 2013). This is because children at these ages are likely to have developed to the stage of cognitive development required to differentiate thoughts, feelings, and emotions, and to be able to retrieve and discuss memories – which are typically involved in CBT (Grave & Blisset, 2004; Zilberstein, 2014). Although CBT can be adapted successfully for younger children, it may require more than eight individual sessions and high levels of parent involvement (Minde et al., 2010). CBT also requires highly trained professionals to deliver therapy that meets modest evidence-based effectiveness parameters. Thus, CBT can be costly and difficult to provide in areas struck by natural disasters, which typically suffer from insufficient health resources.

Overall, CBT delivered in controlled research studies to children and youth with PTSD is quite effective in reducing PTSD symptoms when measured immediately after treatment, but this effectiveness is not maintained over time, and may show little effect a month following treatment (Gutermann, Schwartzkopff, & Steil, 2017; Morina, Koerssen & Pollet, 2016).

Individual Pathways

Research studies have identified consistent patterns in biopsychosocial effects on children following the experience of traumatic events.

However, these consequences are not inevitable—not every child who experiences a traumatic event will go on to develop post-traumatic stress symptoms. There are also changes over time, as children's development proceeds, as they and their family and communities experience more events and learn coping strategies.

It is important to note that research studies document a snapshot in time of a child's condition. Considering all aspects of change, and the plasticity of children's brains, it is essential to study the potential trajectories.

Masten and Narayan (2012) have analysed studied of children's mental health following disasters, war and terrorism – events that affect entire communities. They grouped children's

reactions into five categories and created an illustration of post-disaster pathways for children (Figure 1.3).

The vertical axis represents an individual's functioning as maladaptive (at the lower end of the axis), normal (grey zone), and optimal (at the top of the axis). The horizontal axis represents time. The disaster is illustrated by the downward arrow, which is showing as if it were a single event in time. Following the disaster time point, the pathway representing normal functioning diverges. The post-disaster pathways include (A) stress resistance pathway, with no change in function; (B) resilient or recovery pathway, with decrease in functioning to a maladaptive level followed by gradual recovery to a normal functioning level; C) post-traumatic growth pathway, with post-disaster functioning improving to the optimal zone of functioning (D) post-traumatic stress without recovery during the period under consideration, in which functioning decreases to a maladaptive level and does not improve; and, (E) delayed onset of PTSD without recovery, in which functioning is maintained at a normal level for an indeterminant period before decreasing to a maladaptive level without recovery.

The individual pathways hypothesised in Figure 1.3 4 represent children whose functioning is considered 'normal' before the disaster event. Masten and Narayan (2012) have pictured the 'normal functioning' pathways as lines through the grey zone representing normal functioning. These pathways are shown as if they were at different levels or heights on the vertical axis, but this is only for purposes of producing a clear illustration. As all lines representing individuals beginning with 'normal functioning', these lines should be consolidated into a single line in the pre-disaster phase. [Masten and Naryan (2012) also illustrate different post-disaster pathways for individuals with disabilities or mental health problems present before to the disaster.]

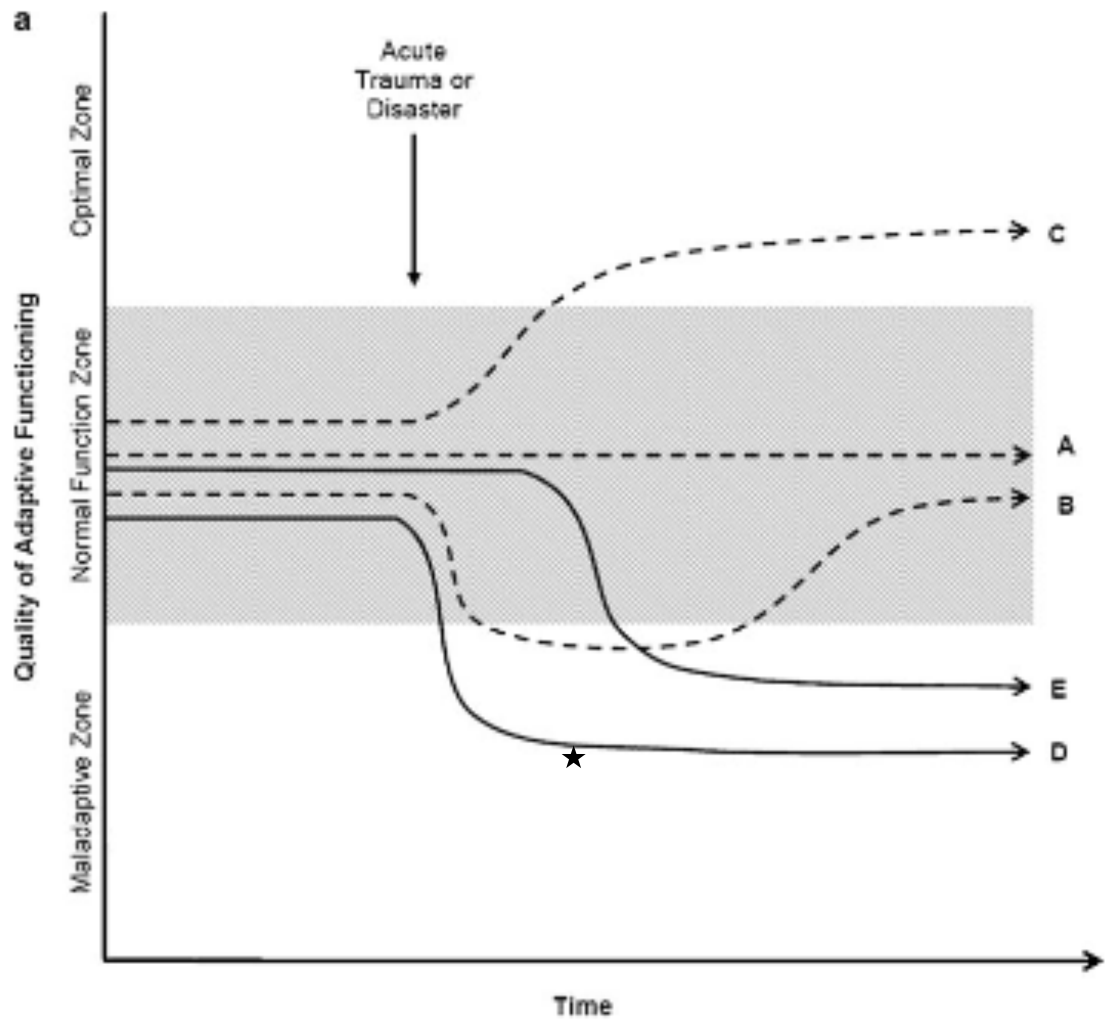

Figure 1.3. "Pathways of Risk and Resilience." From: Masten, A. & Narayan, A. (2012). Child development in the context of disaster, war and terrorism: Pathways of risk and resilience. *Annual Rev Psychol., 63*, 227-257.[7] p. 234. [NB: The "star" has been added. See text for explanation.]

In studies of disasters that are relatively short-lived, post-traumatic symptoms in older children may decrease within 18-36 months, shown as the recovery pathway (Pathway B), although this may not occur when there is a long-term disruption to families and/or communities (Kronenberg et al., 2010) that is associated with further adverse events.

A post-Hurricane Katrina study of 14-year-old-adolescents followed over two school years (Kronenberg et al., 2010) identified the proportion of children on each of the pathways as:

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[7] Under the rules and regulations of the Copyright Clearance Centre, to which the Annual Review of Psychology has assigned its rights, up to 10% of a journal article may be reproduced for 'fair dealings' with appropriate attribution of the copyright holders.

45.2% Pathway A: Stress Resistance
27.1% Pathway B: Post-traumatic Stress and Recovery
Pathway C: Post-traumatic Growth (not measured)
23.0% Pathway D: Post-traumatic Stress without Recovery
4.7% Pathway E: Delayed Post-traumatic Stress without Recovery

A study of 3-6-year-old children referred due to severe PTSD reported pathways D and E= 50% (Schreeinga & Zeanah, 2008). Consolidating the data from these two studies indicates that more than half of the children will be functioning below their normal pre-disaster levels at some point in time before the recovery shown in Pathway B. This point has been marked on Figure 1.3 with a ★).

Masten and Naryan (2012) have hypothesised the individual pathways representing mental health and functioning post-disaster, but this model is limited by not considering the overall ecological context in which children live with their families, their neighbourhoods, their whanau, their schools and communities. Individuals do not suffer from disasters alone, nor do they recover alone, but live within families and communities. And communities also experience pathways, as discussed in Chapter 2.

Although research studies may not reflect the actual impacts of CBT and other forms of therapy in ameliorating children's PTSD symptoms, the state of the research in regards to treatment is quite concerning in the context of the number of children potentially affected with mental health problems when a community is struck by disaster. PTSD in children and adolescents may be undetected or unnoticed in communities as well (Cowles & Davis, 2017). The effects of natural disasters on children's mental health are considered in Chapter 2.

Chapter 2

Natural Disasters and Mental Health

Natural disasters, including earthquakes (EQs), are traumatic events associated with significant and persistent mental health effects in the exposed population that are qualitatively different from the effects of other types of trauma (Carrion, Weems & Bradley 2010; Galea, Nandi & Viahov, 2006). Unforeseen natural disasters affect the entire community simultaneously, significantly changing the types of medical and health services, and community support that is commonly available when individual families experience a traumatic event, and can result in more than doubling of baseline rates of mental health problems affecting an entire birth cohort (Overstreet, Salloum, Burch & West, 2011; Masten & Narayan, 2012; McLaughlin, Fairbank, Gruber, Jones, Lakoma, Pfefferbaum, Sampson & Kessler, 2012) with persistent effects (Moore & Varela, 2010; Najarian, Sunday, Labruna & Barry, 2011; Shaw, Espinel & Schlutz, 2012; Wang, Chan, & Ho, 2013).

Natural Disasters and Sensitive Developmental Periods

Natural disasters disrupt neural development with potential long-term effects similar to other traumatic events (Masten & Narayan, 2012; Overstreet et al., 2011). A particularly serious impact may be sustained if the traumatic event occurs during sensitive developmental periods. Prenatal periods and the ages of 0-12 months are sensitive periods for cognitive, language and emotional development and thus likely to be particularly vulnerable to the effects of disasters (Carrion et al., 2007; 2010). The presence of recurrent threat associated with traumatic events has been shown to produce hyperarousal-dissociative responses, and the longer the period of time during which the child is in a hyperaroused state, the more likely they are to experience negative impacts on cognition and emotional regulatory systems (Sameroff & Haith, 1996; Scheeringa, Zeanah & Myers, 2005).

Although it is commonly believed that younger children would be more resilient, and/or ‘forget’ disasters they experienced at a young age, research has shown this to be false, as rates of PTSD in young children have been reported to range from 17% post 911 to 50% 2.5 years post-Hurricane Katrina (Schreeinga, & Zeenah, 2008). Developmental delay was reported in

15% of children aged 3-5 years from disadvantaged areas of Miami, Florida (USA), 18 months after Hurricane Andrew (Delamater & Applegate, 1995)

In addition to direct involvement in traumatic events, children who experience severe disaster-related stress in utero have been shown to be more likely to be born low birth-weight. These children may also have reduced cortisol levels, depressed IQ scores and language difficulties, as well as poor school achievement (Laplante, Brunet, Schmitz, Ciampi, & King, 2008). These outcomes are consistently related to maternal stress levels during pregnancy and post-natal periods (Masten, 2014). Children may also exhibit co-morbidities, including most commonly ADHD and Oppositional Defiant Disorder/Conduct Disorder. However, these rates are affected by the type of trauma, the timing of assessments, the characteristics of the study group and by measurement-related factors (De Young et al., 2011).

Studies have shown that duration of exposure to disaster events is related to number and severity of symptoms in young children (Swenson et al., 1996). Post-disaster stressors, such as associated with rebuilding and recovery periods, are also thought to provide a continuing cascade of effects on the mental health of young children and their families, adding to the burden and reducing coping capacity (Alisic et al., 2011; Sprung, 2008).

Stress from experiencing traumatic events is very persistent and may last well into adulthood. It is important to note that research has dispelled the persistent myth that children are "resilient" to traumatic events, and bounce back quickly (Carrion et al., Dugan, Snow & Crowe, 2010). This myth seems to have arisen before evidence accumulated as to how children express stress-related difficulties in their behaviour and physical health at different developmental stages.

Earthquakes as Unique Natural Disasters

Earthquakes are unique natural disasters because they occur without warning, can have devastating consequences within a few seconds, and the effects are widespread throughout the community (Chou, Su, Ou-Yang, Chien, Lu & Chou, 2003; Guha-Sapir & Vos, 2011; Shaw, Espinel & Schlutz, 2012). Unlike other natural disasters, such as hurricanes, floods and bushfires, there is no advanced warning to evacuate, protect one's family, or gather emergency supplies before an earthquake. Stress from unpredictable and uncontrollable events may have larger impacts on the brain, as compared with predictable and controllable sources of stress (Tottenham & Sheridan, 2010).

In other disasters that can have multiple occurrences over a short time span, such as hurricanes and fires, there are generally repeated public warnings in the days immediately before it strikes, and these announcements provide government-sanctioned directions regarding evacuation and preparation. This simply was not the case in the earthquakes or the aftershocks, when no advance warning was scientifically possible.

Earthquakes are invisible, as they occur beneath the surface of the earth (Galaea, Nandi & Vaihov, 2005; Ross & Shuell, 1993; Smith, 1999), which makes them much more difficult to explain to children, or for children to understand, as compared to, say, hurricanes or floods, which are visible. The visual image of the disaster provides the autonomic nervous system a time to prepare itself, and also a visual referent, which does not occur with earthquakes.

> *Children and youth are particularly vulnerable to the effects of disasters. They have limited capacity to independently mobilize resources to help them adapt to stressful postdisaster circumstances, and are instead dependent upon others to make choices that will influence their household, neighborhood, school, and larger social environment. Children's mental health recovery in a postdisaster setting can serve as a bellwether indicator of successful recovery or as a lagging indicator of system dysfunction and failed recovery.*
>
> Abramson, D. M., Park, Y. S., Stehling-Ariza, T., & Redlener, I. (2010). Children as bellwethers of recovery: dysfunctional systems and the effects of parents, households, and neighborhoods on serious emotional disturbance in children after Hurricane Katrina.

Earthquakes also generate unique community-wide stressors (Schiff, 1999). Earthquakes destroy essential public services to a far greater extent than other disasters. In other disasters, the distribution of the power, water, and sewage services is disrupted, while in earthquakes, both the distribution networks and the substations are destroyed, resulting in much more extensive damage, and resulting in longer rebuild periods (Schiff, 1999; Chou, Su, Ou-Yang, Chien, Lu & Chou, 2003). Damage to buildings is also different in earthquakes, in that the foundations of many frame and masonry buildings are destroyed, and bridges, wells, and river and stream embankments can be damaged (Smith, 1999). Earthquakes have unique impacts on health care systems because of crush injuries, respiratory diseases from dust and debris, and disruption of basic services due to structural damage to medical centres (Norris, Friedman & Watson, 2002; Norris, Friedman, Watson, Byrne, Diaz & Kaniasty, 2002).

Earthquakes and Post-traumatic Stress Disorder

Exposure to earthquakes greatly increases the risk of post-traumatic stress disorder (PTSD) and post-traumatic stress symptoms (PTSS) in children (Kar, 2009; Overstreet, Sallooum, Burch & West, 2011; Proctor, Fauchier, Oliver, Ramos, Rios & Margolin, 2007): 71.6% of children aged 4-5 years had distress symptoms 8 months after the Northridge, California M6.7 earthquakes (Proctor et al 2007); 42.6% of children in grades 1-9 had probable PTSD eight months after the M9.0 Great Japan earthquakes (Usami, Iwadare, Kodaira, Wantanabe, et al., 2012); 22.9% of children aged 6-10 who lived very near the epicentre of the M5.7 L'Aquilla, Italy, earthquakes had PTSS 12-17 months later (Feo et al., 2014); 54.2% of school children had PTSD 18 months after an M6.9 earthquakes in Armenia (Goenjian, Pynoos, Steinberg, Najarian et al., 1995) and 28% of children aged 8-15 had severe or very severe PTSS 36 months after an M7.4 earthquakes in Marmara, Turkey (Eksi & Braun, 2009). A recent review of PTSD in children following earthquakes identified rates varying from 4.5% to 95%, with differences due to measurement, sampling, and earthquakes severity in different countries (Şalcıoğlu, & Başoğlu, 2008). However, an additional review of 26 studies of children following earthquakes reported that none focused on young children (Wang, Chan & Ho, 2013).

Factors associated with the rate of PTSS following earthquakes include socioeconomic status, ethnicity, and gender, as well as the experience of other traumatic events (Furr, Comer, Edmunds & Kendall, 2010; Şalcıoğlu, & Başoğlu, 2008). The effects of earthquakes may also differ across countries, due to the availability of resources to address post-disaster conditions, including health and infrastructure capabilities, and according to the magnitude and features of the earthquakes, such as whether a tsunami was also experienced (Shaw, Espinel & Schulz, 2012).

The number of people affected by PTSS following earthquakes may reduce over time. For example, PTSD reduced from 40% of adults to 19% over two years after the 5.6 earthquakes in Newcastle, Australia (Carr, Lewin, Webster, Kenardy, et al., 1997). However, PTSS is likely to persist for years in vulnerable groups, such as low-income mothers and young children. (Paxson, Fussell, Rhodes & Waters, 2012; Rhodes, Chan, Paxson, Rouse et al., 2010; Scheeringa, 2008).

Between the ages of 12-60 months (the ages at which study children experienced the Canterbury earthquakes), children would typically progress through sensorimotor and preoperational thought, and develop trust, autonomy, and empathy as socio-emotional development. Research has shown that children younger than about seven years do not understand the concept of chance events, and often attribute intention or purpose to such events (Piaget & Inhelder, 2014). Thus, conventional explanations for earthquakes (EQ) as 'chance' or 'accidental' which are used to reassure and help older children and adolescents, cope with disasters, are unlikely to be understood or ameliorate symptoms in young children (Prinstein et al., 1997).

The Role of Parents

It is important to note that, in the case of reactive PTS associated with earthquakes, parenting does not "cause" PTS. For instance, a parent being upset after the moment the earthquake strikes is not the cause of PTS. Research indicates that children can exhibit PTS symptoms independent of parenting styles and a recent review reported parenting contributed only between 2-5% of the variability in children's symptoms (Salmon, Sinclair, & Bryant, 2007; Williamson, Cresell, Fearon, Hiller, Walker & Halligan, 2017). Two recent reviews of treatments both reported that including parents in the treatment did not have any impact on treatment outcome (Gutermann, Schwartzkopff & Steil, 2017; Morina, Koerssen, & Pollet, 2016). The lack of effect of including parents in treatment may be because parenting behaviour is not the cause of behaviour problems and because treatments tend not to address the biological roots of PTSD.

When an earthquake strikes, there is no warning. There are no calls to evacuate or warning sirens. This means that there are no possible self-regulatory processes that an individual can evoke before the traumatic event – no way to prepare the autonomic nervous system for what is about to happen. Thus, it is unlikely that parental actions can prevent the arousal the child experiences at the moment of earthquake strike.

The child's fear response system, including the amygdala and the HPA axis, is automatically activated by the sensation of the earth shaking and the accompanying noise and visual signals. It is the child's bodily proprioception of an earthquake that immediately activates the HPA axis, not anything caused by parents, or a parent's reactions at the time an earthquake struck. Children experienced more than 15,000 earthquakes and aftershocks in the Christchurch area (Geonet Science, 2014), and it is the duration of the EQ period, the number of repeated HPA

activations, and the timing of these events during the sensitive periods of child development that has caused the post-traumatic stress in children. Similarly, if one puts one hand on a hot surface, there is an automatic fear reaction and a withdrawal of the hand from the surface. These are not self-regulated thinking responses, and these responses are not in reaction to parenting.

The bodily experience of fear occurs independently of and before the parent's subsequent reaction to the child's hurt or expression of fear. In the Christchurch earthquakes, this fear activation of the amygdala and the HPA axis occurred many times, and, most likely, more than 100 times. Even adults will have an initial fear reaction to earthquakes. Although the level of this activation may fade over time, it is not clear that this fading also happens in young children.

These repeated experiences dysregulate the autonomic nervous system, as previously explained, and lead to PTSD, or PTS, with the symptoms expressed in children's behaviour. A recent study indicated that even a twenty-minute warning could reduce the negative mental health effects of being forced to flee one's home due to flooding (Munroe et al., 2017). This twenty-minute warning, given via text message, news media, social media, or other media provides the opportunity to plan and establish coping strategies, including giving the body a warning as to what is about to happen. This is complementary evidence as to the fact that earthquakes, for which no warning system yet exists, may result in higher levels of post-disaster effects.

While parents are not the causes of their children's behavioural expressions of PTS, they are likely to react to them. Research indicates that when children have PTS, parents and families become upset and worried, and stress increases (Cobham, McDermott, Haslam & Sanders, 2016). Parents may react negatively to their children' behavioural trauma expression, for example, and then use corporal punishment which would have an adverse impact on their child. Or, parents may experience domestic violence or psychopathology (including maternal PTSD or other mental health problems themselves), which are more likely to occur post-disaster, and these conditions will affect children. If a parent develops PTS, particularly if the father becomes more irritable himself, this may affect children (Kilic, Ozguven & Sayil, 2003).

Post-disaster events can produce delayed onset of PTS due to the cumulative impacts of traumatic events (having a parent with a mental health problem can cause PTS independent of experiencing earthquakes) or having difficulty with recovery from PTS. Similarly, teachers

are not the cause of children's behaviour problems. Parents and teachers do not need to "blame" each other for children's PTS related behaviours, but instead must both work together to improve children's well-being (Juth, Silver, Sele, Widyatmoko & Tan, 2015; Spell et al., 2008).

The Uniqueness of the Canterbury Earthquakes

Canterbury experienced an unprecedented series of large earthquakes, beginning with an M7.1 earthquake on 4 September 2010, which disrupted the community, closed schools, destroyed much of the infrastructure and damaged family homes (McColl & Burkle, 2012). This was followed by seven earthquakes of M≤5.0 (Table 2.1). Then, on 22 Feb 2011 at 12:51 pm, a shallow M6.2 earthquake with an epicentre within Christchurch city limits and upward ground acceleration velocities of 27.6 -72.6 cm/s hit (Crowe, 2013; Cubrinovski, Huges, Bradley, McCahon et al. 2011; Daily Mail Reporter, 2010). This earthquake resulted in 6600 injuries and 185 deaths, in a population of about 440,000 (McColl & Burkle, 2012; Thornley, Ball, Signal, Lawson-TeAho, & Rawson, 201). This was followed by more earthquakes of M5.0 or greater over the next 11 months, and approximately 14,000 aftershocks of lesser magnitude (Crowe, 2013; Geonet Science, 2014). (Table 2.2)

This series of earthquakes is unique because of the extended period over which large magnitude earthquakes were experienced and because of very strong vertical ground accelerations which lifted buildings off their foundations (McColll & Burkle, 2012; Fergusson & Boden, 2014; Reyners, Eberhart-Philips & Martin, 2014).

The earthquakes caused liquefaction across the central and eastern parts of the city, destruction of the power, water, and sewage systems, extended school closures, destruction of 10,000-15,000 family homes, damage to more than 110,000 family homes of an estimated 140,000 pre-earthquake, and caused a significant drop in the nation's gross domestic product (Chang, Taylor, Elwood, et al., 2014; Chang, Wilkinson & Seville, 2012; Cubrinovski, Robinson, Taylor, Hughes & Orense, 2012; Ferris & Petz, 2012; Giovinazzi, Stevenson, Mitchell & Mason, 2012; Guha-Sapir, Voc, Below & Ponserre, 2012; Ham, Cathron, Winter & Winter, 2012; Massie & Watson, 2011; Ministry of Education, 2012; Van Ballegooy, Malan, Elwood, et al., 2014).

The frequency, severity and short intra-quake intervals of the Canterbury earthquakes meant that residents repeatedly experienced acute events, immediate disaster responses, and longer-term consequences of the disaster in overlapping pathways. This impeded recovery and increased the risk of mental health problems, as well as reduced well-being.

Due to the prolonged and repeated experience of more than 14,000 earthquakes and aftershocks, this sequence is classified as Type 2 trauma exposure –one that involves repeated exposure to traumatic events.

Aftershocks are not Afterthoughts

Main earthquake and aftershocks from 4 September 2010 to 22 February 2011.

The main earthquake struck on 4 September 2010, and all of the earthquakes since have been described as 'aftershocks', as, geophysics attributes the subsequent earthquakes to the changes in the earth's crust associated with the main earthquake.

Unfortunately, the term 'aftershock' seems to indicate that these earthquakes are of minimal importance, even 'afterthoughts.' Therefore, to demonstrate the actual strength of these events, the 'aftershocks' of magnitude 5.0 or greater that occurred before the 6.3 earthquake in February 2011 are listed below (Table 2.1). This list of 'aftershock' earthquakes must be taken in context, as earthquakes of magnitude 3.0 are covered in the newspapers of other countries and are often felt by residents (Quakebot, 2017), but only M5.0 earthquakes are listed here.

Table 2.1. Magnitude >5 earthquakes from 4 September 2010 to 22 February 2011

Date	Richter Magnitude	Earthquake Epicentre	Depth (km)
4 Sept 2010	5.8	38 km SW of Christchurch	
4.Sept.2010	7.4	40 km SW of Christchurch	10 km
8 Sep.2010	5.1	10km NW of Diamond Harbour	6 km
19 Oct 2010	5.0	9 km from CBD	9 km
26 Dec. 2010	5.1	5 km from CBD	"shallow"
20 Jan 2011	5.1	10 km	

The period between the first earthquakes on 4 September 2010 and the deadly earthquake of 22 February 2011 has been called the period of earthquake innocence (van Beynan, 2015) because the relatively few injuries (about 100) or deaths (1 heart attack) directly related to the September 2010 earthquake seemed to have given residents a false sense of security about their resilience and safety, even though the main earthquake on 4 September lasted more than 40 seconds, and destroyed many buildings. This under-estimation of risk may be common with earthquakes (Celsi, Wolfinbarger & Wald, 2005).

Earthquakes from February 2012 to January 2012

However, the most severe and long-lasting period of earthquakes was to follow during the 12-month period to January 2012. This period included 30 earthquakes of magnitude 5 or greater, and more than 14,000 total aftershocks (Table 2.2). This time period of earthquakes and aftershocks is unusual in its length, severity, and occurrence so close to a city centre.

Table 2.2. Main Canterbury aftershocks between 22 February 2011 and January 2012 of Magnitude 5.0 and above that struck Christchurch beginning with the 22 Feb 2011 earthquake through January 2012, from Geonet Science.[8]

Date	**Richter Magnitude**	**Earthquake Epicentre Relative to Christchurch Centre**	**Depth (km)**
22 Feb 2011	6.3	10 km south	5.0 km
22 Feb 2011	5.8	10 km south	5.9 km
22 Feb 2011	5.9	Within 5 km of Lyttelton	6.72 km
22 Feb 2011	5.1	Within 5 km of Lyttelton	7.3 km
22 Feb 2011	5.0	Within 5 km	12.0 km
22 Feb 2011	5.0	20 km SE	12.0 km
5 Mar 2011	5.0	10 km SE	9.5 km
20 Mar 2011	5.1	10 km E	11.83 km
16 April 2011	5.3	20 km SE	10.6 km

[8] https://en.wikipedia.org/wiki/2011_Christchurch_earthquake#cite_note-GeonetAftershocks-50

Date	Richter Magnitude	Earthquake Epicentre Relative to Christchurch Centre	Depth (km)
30 April 2011	5.2	60 km NE	8.7 km
10 May 2011	5.2	20 km W	14.4 km
6 June 2011	5.5	20 km SW	8.1 km
13 June 2011	5.9	10 km SE	8.9 km
13 June 2011	6.4	10 km SE	6.9 km
13 June 2011	5.1	10 km SE	10.2 km
15 June 2011	5.2	20 km SE	5.8 km
21 June 2011	5.4	10 km SW	8.3 km
22 July 2011	5.3	40 km W	12 km
2 Sept 2011	5.0	10 km E	7.6 km
9 Oct 2011	5.5	10 km NE of Diamond Harbour	12.0 km
23 Dec 2011	5.9	20 km NE of Lyttelton	8 km
23 Dec 2011	5.3	21 km ENE	10.1 km
23 Dec 2011	6.0	10 km N of Lyttelton	6 km
23 Dec 2011	5.1	20 km E	10 km
24 Dec 2011	5.1	10 km E of Akaroa	9 km
2 Jan 2012	5.1	20 km NE of Lyttelton	13.3 km
2 Jan 2012	5.5	20 km NE of Lyttelton	13.5 km
2 Jan 2012	5.5	20 km NE of Lyttelton	13.5 km
6 Jan 2012	5.0	20 km NE of Lyttelton	6.7 km
7 Jan 2012	5.3	20 km E	8.4 km
15 Jan 2012	5.1	10 km E	5.8 km

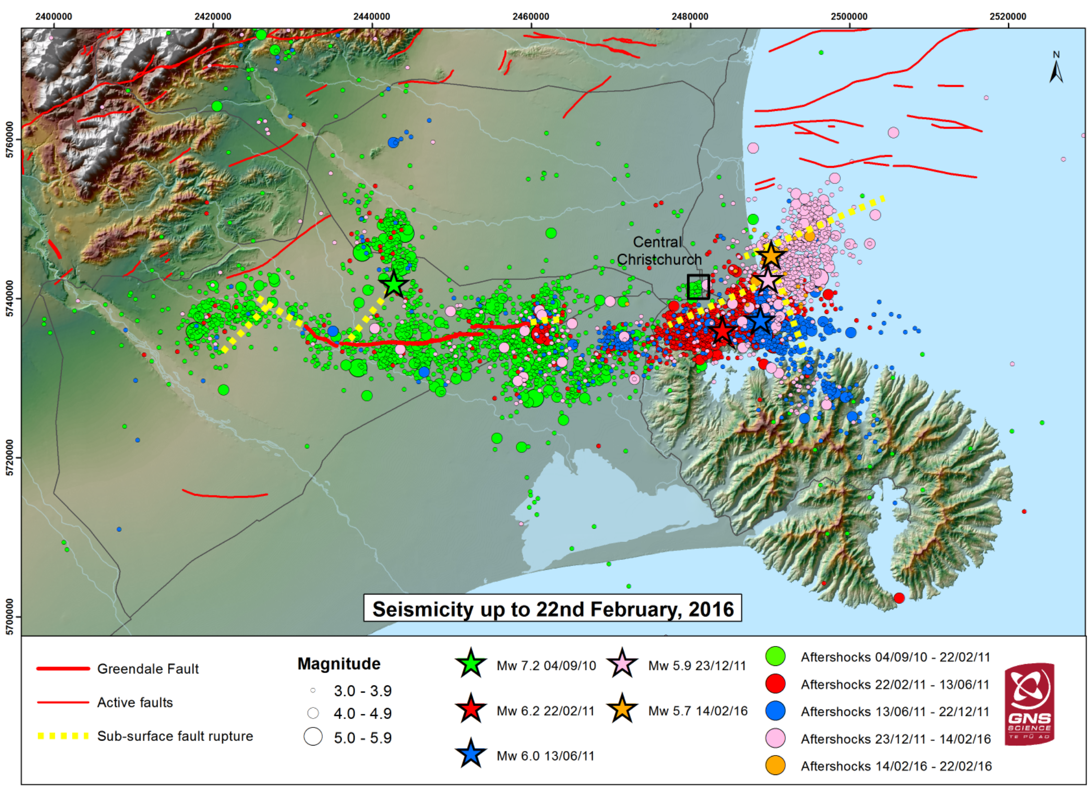

Figure 2.1. Earthquake and aftershocks to February 2016. GNS Science.

Earthquakes From January 2012 to October 2017

Additional large earthquakes have continued to strike the Canterbury area, with 70 earthquakes of M5.0 or greater to October 2017. This included a magnitude 7.8 earthquake striking North Canterbury just past midnight on 14 January 2016; within one week, there were more than 3,700 ‘aftershocks’. The continuing exposure and the extended duration of earthquakes comprise one of the most important predictors of the development of post-traumatic stress symptoms in children and adults. Another significant risk factor is exposure to further adverse events, as risk accumulates with additional exposure. Thus it is important to consider these adverse events in post-earthquake Christchurch.

Post-disaster Stressors in Christchurch

The aftermath of a natural disaster can create a *Cascade of Stress*. Some researchers believe that it is exposure to the vast number of post-disaster stressors and the duration of the exposure over years that is the real cause of post-traumatic stress. For example, neighbourhoods with vacant or broken-down buildings and broken roadways are constant reminders of the disaster and these visual reminders can have a significant negative effect on

household and parent stress levels in families, affecting rates of emotional and behavioural problems independent of other factors (Abramson, Park, Stehling-Ariza, & Redlener, 2010).

Stress from a disaster can also increase risky behaviour, such as alcohol and drug abuse, and problem gambling. Such behaviour can be early warning signs of mental health issues. In May 2011 Chief Science Advisor Professor Sir Peter Gluckman indicated that up to 5 percent of the population might continue to have significant psychological ill health requiring professional help as a result of the earthquakes. International experience suggests that post-disaster stressors, such as delayed decisions about property and insurance, are some of the most significant factors that increase the risk of mental ill health and hold back recovery. These 'secondary stressors' are circumstances, events or policies that are indirectly related or 'non-inherent and consequential' to the earthquakes. Examples are housing difficulties; problems with insurance; and loss of social networks. -CERA Well-being Report 2013 (*Mental Well-being,* p. 1).

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Figure 2.2. Catholic Cathedral , March, 2011

Christchurch has experienced significant stressors since the first earthquake in September 2010, but, given the continuing earthquakes, it is not clear that the region is actually in a "post-disaster" phase. The stressors have included the frequent and extended loss of electricity, water, and waste infrastructure, the imposition of Emergency Management Act passed by Parliament and related controls, including the suspension of elections. More than 10,600 people left Christchurch in the aftermath of the disaster

CERA estimated that 171,00 properties were damaged, and more than 12,00 were seriously damaged, and more than 13,000 were uninhabitable. CERA created a system of classifying land according to the degree of damage and risk potential, and every residential property was classified (Figure 2.2). A residential area of 630 hectares and more than 7,800 homes east of the city centre was declared unfit for housing, residents were paid compensation by the government based on 2007 valuations, and the entire area, known as 'the red zone', was cleared of dwellings (although one home remains inhabited in August 2017). The risk level assigned to a property affected how the rebuild or repairs could proceed, as well as making a significant impact on property values.

The widespread loss felt by the community as a result of the damage has been reported by the New Zealand Geographic, in "Red Zone":

> "Communities have gone or dissipated or split in half," says Evan Smith, a former resident of a red-zoned street, no co-chair of the Avon-Otakaro Network (AvON). "There used to be whole communities of people using this river space: whitebaiters, people biking or walking their dogs. It was a whole social corridor – that is what has been taken away." (Blundell, 2014).

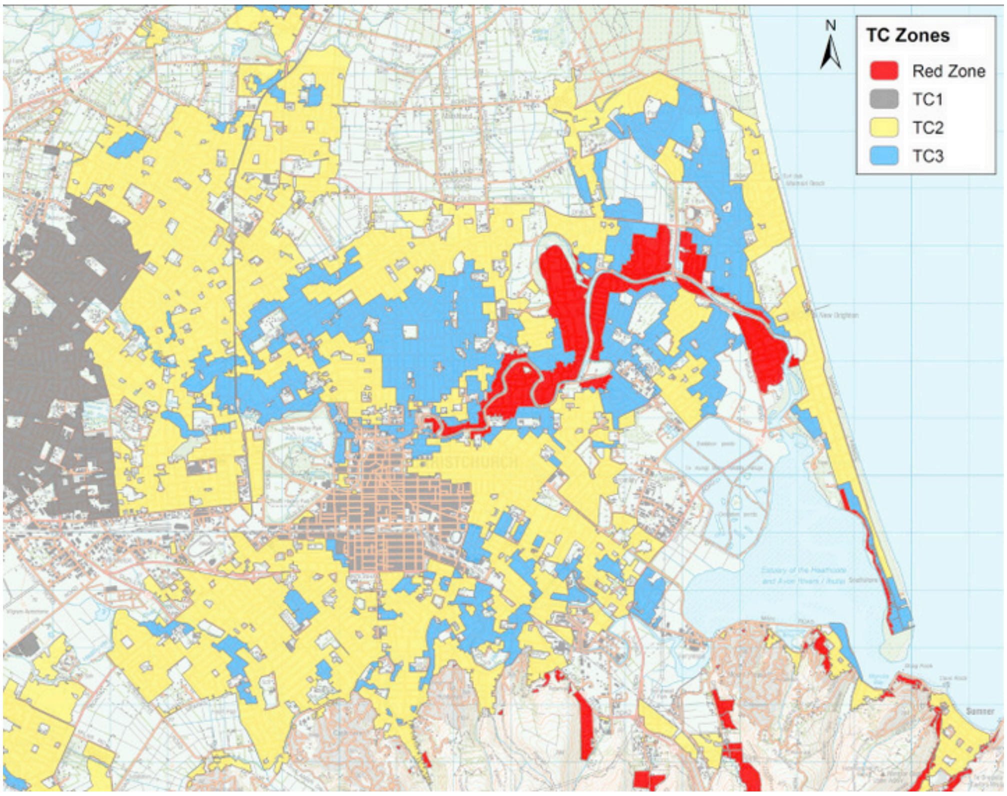

Figure 2.3. CERA Land Classifications (CERA, 2012). Technical Category 1 (grey) shows land that was considered low risk, TC 2 (yellow) shows minor/moderate risk and TC3 (blue) shows moderate to significant risk. The red zone indicates neighbourhoods where all residences were demolished, and no building or rebuilding was permitted due to extreme

In 2012, more than half of the respondents to the CERA Well-being Survey reported that they lived in a damaged home. There was a related loss of social housing, with 95% of social housing units sustaining damage. Subsequently, rents in available homes increased to high levels (35.7% increase from November 2010 to November 2013). Increasing house and rent prices, coupled with the loss of homes due to damage, was associated with crowding, and with more people living in substandard circumstances (CERA Well-being Survey, 2013, 2014). Living in substandard circumstances, as well as changed economic circumstances caused by rent inflation, can contribute to the development of mental health problems, and behavioural and developmental problems in children (Superu, 2014). For children, moving homes can also mean a lost of friends, pets (many rentals would not accept pets), and a change in schools, as well as increased inter-family stressors.

Families also reported stress related to insurance claims on their damaged properties. While one in 2.7 residents reported difficulty with insurance in 2012, in 2014, one in five residents were still reporting difficulty with insurance, and 29% reported stress associated with

decisions about repair and rebuild of their homes. By April 2015, 13% were continuing to report stress associated with insurance and their homes (CERA Well-being Survey, 2015) and 38% reported stress from living in a damaged environment. These data indicate many people are affected by these aspects of post-disaster stress in Christchurch.

Employment changes are also associated with post-disaster phases. In 2012, it was reported that more than 10,600 people had left Christchurch (Wright, 2012). The unemployment rate peaked at 7.1 % in March 2011 and fell to 3.3 % by March 2014 (well below the New Zealand average of 6.2%) (CERA Well-being Survey, 2014). However there was a shift in the type of jobs, with most new employment related to construction and infrastructure repair, and also people choosing to quit work for different reasons (Wood, 2013). Changes in employment due to loss of workplaces, or closure of affected businesses are also associated with additional family stress.

Several floods have also occurred in Christchurch neighbourhoods and the study schools. Parts of Christchurch that have experienced severe flooding in 2012, 2013, 2014, 2015 and 2016. One map of flooding is shown in Figure 2.3.

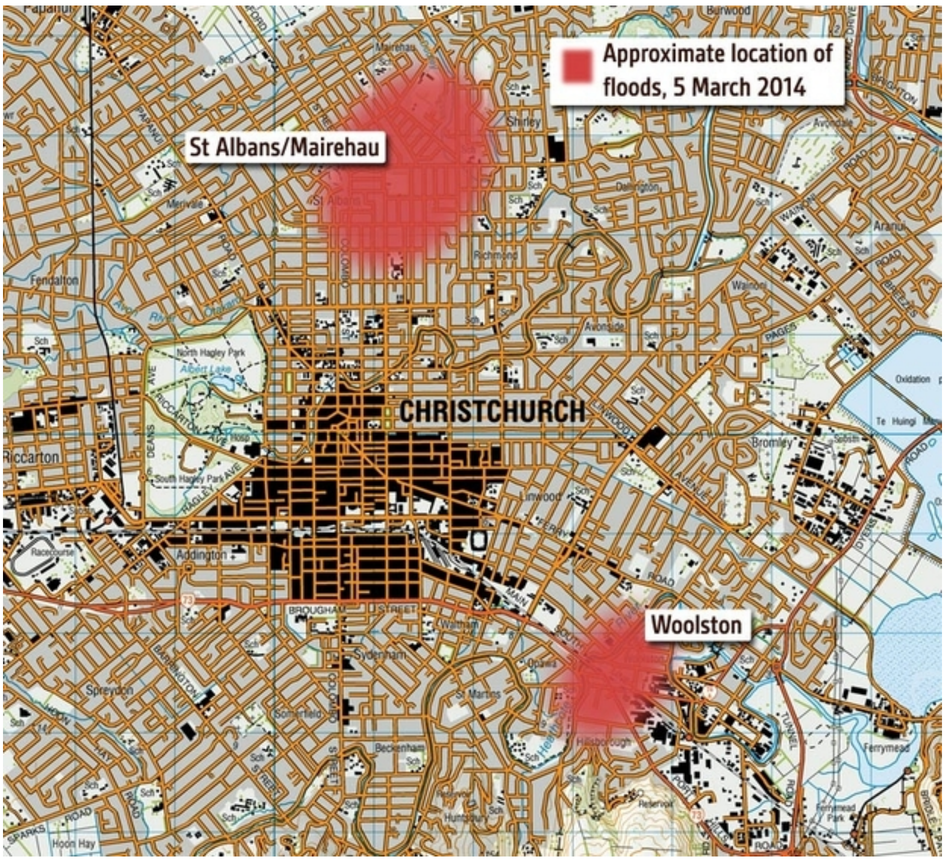

Figure 2.4. Map showing areas in red worst affected by flooding in 2014. Source:

http://www.radionz.co.nz/news/national/238054/christchurch-to-speed-up-flood-protection-work
Many different adverse events, both individual and community, have affected Christchurch since September 2010. These have contributed to the mental health of its residents.

Phases of Disaster and Disaster Response in Canterbury

There are many different ways that adults or children respond following a traumatic event. In the immediate aftermath of a disaster, adults and children can respond in complex ways. The typical types of supports and resources in the community, their life experiences and coping skills, as well as the types of disaster-related events that they experience, affect these immediate responses. In the immediate aftermath, it would be expected that everyone would have reactions, ranging from constrained to emotionally expressive. However, reactions that are delayed after the initial exposure can also be quite extreme. (For a comprehensive list of reactions, compiled from numerous research studies, see Table 3.1 in *Trauma-Informed Care in Behavioral Health Services*, 2014).

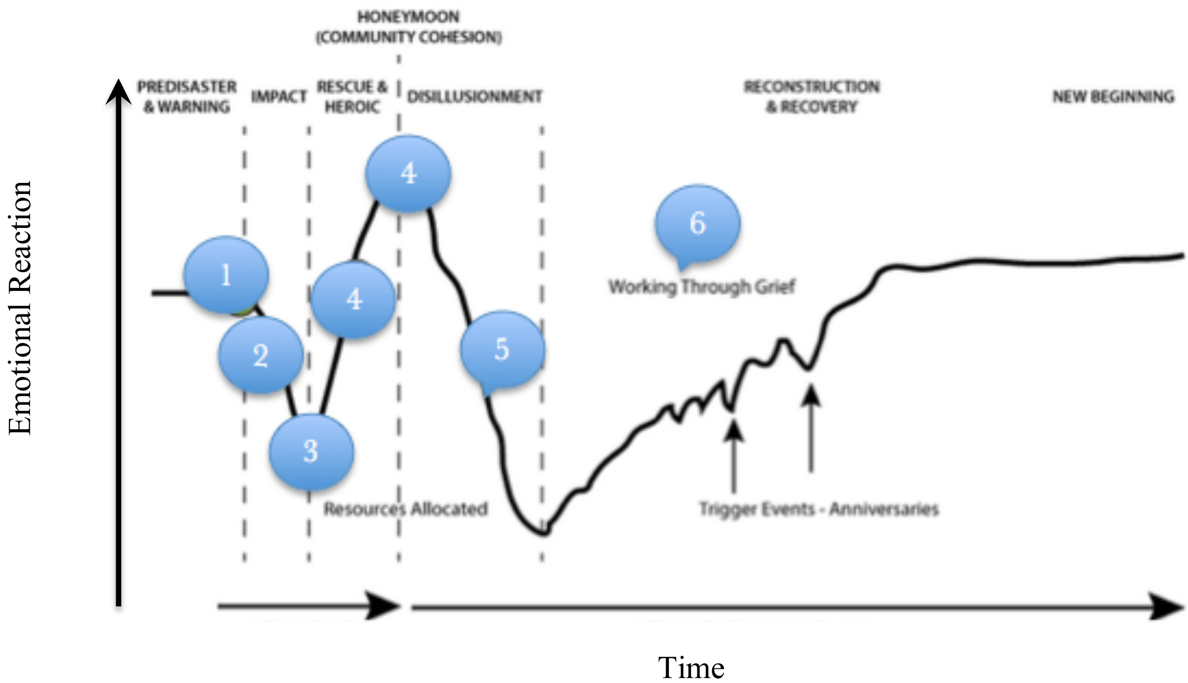

Figure 2.5. Phases of a Disaster and Community Emotional Responses. (Adapted from U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. *(2000). Training manual for mental health and human services workers in major disasters, second edition*: Washington, DC.)

The emotional reactions in a community struck by disaster have been described as falling into a pattern of six phases, as shown in Figure 2.5.

1. Pre-disaster Phase (normal life) and warning phase—fear heightens. Warnings may be non-existent, as in earthquakes, or they may be days or weeks in advance (e.g., floods, hurricanes).

2. The Impact Phase, when the disaster strikes.

3. The Heroism and Rescue Phase. People watch out for, protect, and even risk their own life for strangers. There may be a sense of euphoria.

4. The Honeymoon Phase. People pitch in, collaborate and help each other.

5. The Disillusionment Phase. People feel that too little is done, too late, that there are not enough resources or help, or that resources are poorly and inefficiently distributed, or that needs are ignored. This is the phase in which post-disaster stressors can have negative impacts on mental health.

6. Reconstruction and Recovery Phases. The experiences of working through grief and disillusionment bring about recovery and rebuilding. Trigger events and stressors associated with the after-effects of disasters can lengthen this phase.

Figure 2.6. Memorial Service 22 February 2012, Hagley Park.

However, in the case of the Canterbury earthquake, the model of disaster phases shown in Figure 2.5 is not so easily applied. If even the three major earthquakes of September 2010, February 2011 and June 2011 are considered, the Community Emotional Response Phases might start to resemble the figure below, with overlapping phases creating a type of disaster-relevant rollercoaster.

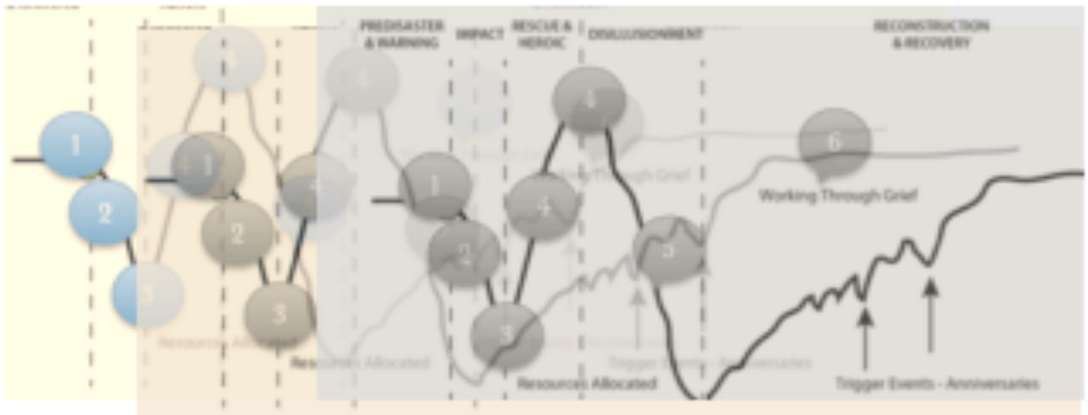

Figure 2.7: The emotional phases of disaster for each of three earthquakes, overlaid to create a rollercoaster effect.[9]

Figure 2.7 does not even begin to give an accurate picture. First of all, keep in mind that severe earthquakes have continued in recent months (e.g., a 4.8 earthquake on 1 March 2017), to bring the overall total of to more than 20,000. Second, the events represented in the diagram do not include the individual events that have affected families, such as fatal automobile crashes (33 in 2017 to 7 August 2017[10]), drownings (14 in 2015), and cancer diagnoses (2738 people were diagnosed with cancer by the Canterbury District Health Board in 2014).[11] These adverse events are associated with negative mental health effects and impacts on families. However, even these few statistics do not give an overall picture of the continuing issues in Christchurch that are affecting children, families and this community.

The longitudinal effects of almost constant exposure to earthquakes, post-disaster stressors and from potentially adverse individual family events over an extended period of time on

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[9] Figure created by Kathleen Liberty, August 2017.

[10] https://www.nzta.govt.nz/resources/road-deaths/toll.html

[11] http://www.health.govt.nz/publication/new-cancer-registrations-2014

young children's psychological, social and cognitive development, and mental well-being are unknown in the literature. Children are part of a community, and their developmental response to a disaster event can not be completely understood as 'individual pathways', as children's development, as has been famously stated, requires a community. Thus, an understanding of children's mental health must be seen not only from an individual perspective, or even a family perspective but a community-wide perspective.

Figure 2.8. Victoria Street re-opens, 2013.

Mental Health in Post-Earthquake Christchurch

The Canterbury Earthquake Recovery Authority (CERA), which manages the government response to the earthquakes, has been responsible for reporting on well-being since 2012. The New Zealand government, the Canterbury District Health Board, the Christchurch City Council and many other organisations have provided extensive mental health services and support to the community, including a wide range of different service types, from a community-wide campaign to improve well-being in the population to individual

counselling.[12] By 2014, more than 24,000 residents had accessed individual counselling services, and more than 8,000 households had received information and practical help.

Positive mental health trends have been reported following the earthquakes. For instance, in September 2012, 45% of survey respondents reported an enhanced appreciation for life, 41% reported pride in their own coping ability, and 21% reported stronger positive feelings for their community (CERA, 2015). However, by 2015, those reporting positive effects had fallen to 27%, 22%, and 17%, respectively.

The CERA Well-being report (2013) found that 80% of the Christchurch residents they surveyed in 2012 reported experiencing stress sometimes or more often. Additionally:

> *Two thirds (66 per cent) of greater Christchurch respondents reported experiencing 'distress or anxiety associated with ongoing aftershocks', and, for 42 per cent of respondents, this has had a moderate or major negative impact on their everyday life. In addition, one third (32 per cent) reported 'dealing with frightened, upset or unsettled children'. The stresses caused by events like earthquakes and the associated secondary stressors can put pressure on relationships, with 28 per cent of respondents reporting 'relationship problems (arguing with partner/friends)'. (page 4).*

The CERA Well-being Report for 2014 stated that, in 2013, 78% of residents reported stress which had a negative impact on them, and 23% said that they were affected negatively by stress "always" or "most of the time". The Christchurch longitudinal study reported that adults in their early thirties who had experienced at least some of the earthquakes had a 40% increased likelihood of mental disorder two years after the February 2011 earthquake, as compared to those who were not earthquakes-exposed (Fergusson, Horwood, Boden & Mulder, 2014).

Between 2013 and 2015, those reporting that stress that negatively affected them always or most of the time remained steady at about one in five survey respondents, with about 75% reporting that stress affected them negatively at least some of the time (CERA, 2015), despite

[12] There are numerous reports and research studies about the mental health and well-being impacts of the earthquakes and post-disaster stressors. Only a very brief description is provided in this section. For more information, please refer to the CERA Well-being Reports, easily available on the web or from a local library.

the investment in a well-funded community well-being project (Calder, D'Aeth, Turner, Fox, & Begg, 2016).

The demand for specialist health services for young people was up 24% in the period June-September 2012, compared with the same period in 2011 (CERA, 2013, p.6-7). But, by 2014, CERA had reported a 30% increased demand for emergency psychiatric services for the most acute mental health problems. Compared with pre-earthquake levels, the demand for mental health services had increased by 700 adults and 300 children per month by March 2017 (Meier, 2017).

Secondary students on the East side of Christchurch were particularly noted as suffering from mental health problems including anxiety, low self-esteem and self-harm (The Prime Ministers Youth Mental Health Report, 2016). NZ has the highest youth suicide in the world (McConnell, 2016) and suicide is associated with PTSD (Panagioti, Gooding, Triantafyllou, & Tarrier, 2015). In 2016, Canterbury recorded the highest suicide rate in New Zealand (Wright, 2016), with many linked directly to the earthquakes (Carville, 2016).

Limitations of Existing Research

The existing research on PTSS following disasters has some significant limitations. The limitations affect the how useful the research is for assisting the understanding of and response to the earthquakes and other disasters in this community. One significant limitation is that few studies have a baseline rate of post-traumatic stress in the pre-disaster phase. Another limitation has to do with the age of the children, as children's PTSS may be influenced by age at the time of disaster, with significant effects associated with disruption during sensitive periods of development (Masten & Osofsky, 2010; Overstreet, Salloum, Burch & West, 2011; Usami, Iwadare et al., 2012).

Osofsky and colleagues (2009) identified age as a predictor of the need for mental health services, with younger children more in need of mental health services. This may be due to the length of time a child has to develop before a disaster strikes, as it is the time prior to a disaster that children (and adults) develop coping skills. The shorter the time period between birth and the disaster strike, the younger the child is at the time of the disaster, and thus a shorter time period to develop coping skills as compared to an older child. Alternatively, the greater impact on younger children may be due to the impact of traumatic events on the brain,

with younger children more likely to be affected due to the timing of sensitive periods of development.

Another limitation is that studies do not correlate their findings according to the age of the child at the time of the disaster impact, and instead report primarily their age at the time of measurement. Studies also often group children across developmental periods for analysis without considering age, even though developmental status is an important predictor of PTS (Norris, 2006). For example, reporting study results for ages 8 to16 years as a single group even though the age range cuts across several key developmental periods (e.g., Jia, Shi, Duan, Liu et al., 201), or reporting results for two different age groups without any explanation as to the reason for the grouping (e.g., Bal, 2008). Recently a meta-analysis which reported ‘age’ to be a minor factor in predicting PTSD did not even include any studies of young children (Trickey, Siddaway, Meiser-Stedman, Serpell et al., 2012). These analytical limitations affect understanding of the developmental and age-related impacts of disasters on children and youth.

The limitations of the literatue, the prolonged duration of the Canterbury earthquake events, and the accumulation of “post-disaster” stressors mean that the Canterbury communities are in a unique situation. There is little reliable guidance or direction for disaster-struck communities available from the published research. Thus, the Juniors study explained in the next chapter, was designed to provide information to assist in understanding and aiding children affected by the the Christchurch earthquakes.

Figure 2.9 “Christchurch Rebuild”, 2013.

Chapter 3
Study of Children's Behaviour Following Exposure to Earthquakes and Post-Earthquake Stressors

Introduction

More than 30,000 young children were exposed to the Canterbury earthquakes and post-earthquakes stressors. Some research suggests that the majority of parents and children are likely to have experienced a low level of distress and will quickly recover to stable pathways of healthy functioning (Bonanno, Brewin, Kaniasty & La Greca, 2010). However, the Canterbury earthquakes and post-earthquake events have been a source of stress over an extended period, as described in Chapters 1 and 2. Thus, children exposed to the earthquakes and post-disaster events are likely to have an increased risk of PTSS as they enter school as compared to children who entered school before the earthquakes began (Carrion, Weems & Reiss 2007; Masten & Narayn, 2012; Overstreet, Salloum, Burch & West, 2011; Shirlaw, 2014).

Anecdotal information from teachers supports these concerns. Teachers from schools on the East and South sides of Christchurch reported that children entering schools since the earthquakes in 2010-2012 were experiencing greater challenges settling into school and learning than children before the earthquakes. The manager of the support services for learning and behaviour for schools in the affected parts of Christchurch, Maureen Allan, was concerned by the increasing referrals to the service, and particularly by the increase in requests for assistance with five-year-old children just entering school, and also reported in the newspaper (e.g., Law, 2011; 2013).

It was hoped to determine whether the anecdotal teacher reports of differences were quantifiable. That is, whether the behaviour and learning of the children entering schools after the earthquake period (which was incorrectly thought to have ended) were measurably different to the behaviour of children who entered school before the earthquake period, Such a comparison was possible because of data from an earlier study, which also involved children just starting school in 2006 to 2007 (Liberty, Pattemore, Reid & Tarren-Sweeney, 2016). That earlier study involved eight schools, six of which were, by random chance, in the East and South parts of the city later most strongly affected by the EQ. As a result of discussions with

local educators post-EQ, it was determined that the earlier study could serve as a baseline for a study replicating the teacher measures with earthquake exposed children as they entered school, and thus could potentially identify differences in the two groups of new entrants,

Study Aims

In the Juniors Settling into School and Learning project, the first aim was to determine if children who were entering school after the earthquakes in 2012, 2013, 2014 and 2015 were displaying behavioural patterns different to children who entered schools in 2006 and 2007. The second aim was to follow these children as they settled into school during the junior school years.

Participants

Ethical Approval

Procedures of both studies, one in 2005-2008 and one from 2012 to the present, were approved by the Human Ethics Research Committee of the University of Canterbury (Education), and by the Boards of Trustees of participating schools. The procedures used in the Pre-Earthquake study were also approved by the New Zealand Health and Disability Ethics Committee (South Island).

Pre-EQ Group

Approximately four years prior to the EQ period, a cohort study of children's health and learning at entry to primary school was conducted in Christchurch by the study authors (Liberty, Pattemore, Reid & Tarren-Sweeney, 2010) and funded by the Asthma and Respiratory Foundation of New Zealand and the University of Canterbury.

Pre- Earthquake Schools

Schools were individually approached in a randomly determined series from a list of all Christchurch primary schools, to identify those with sufficient numbers of predicted new entrants to meet the planned sample size. The Ministry of Education employed a classification of schools across aggregate socioeconomic indicators, derived from census data, which consists of 10 decile bands, each representing 10% of schools. In this classification system, Decile 1 includes the most disadvantaged schools and Decile 10 the most advantaged. School decile ratings were determined on a biannual basis from address sampling by the Ministry of Education. In the Pre-EQ study, the Ministry of Education's decile bands were used to sort

schools into lists by decile, and then randomly within decile. Schools were categorised as high decile, mid-decile and low decile, and schools were approached within the random order generated. Eleven schools were approached, and eight schools agreed to participate. Three schools declined: one because the school felt 'there was nothing in it for them', one because the principal was retiring and no new principal was available, and one because the teachers in the two New Entrant classrooms had given notice and the principal was not sure that new teachers would be willing to participate.

Pre-Earthquake School Characteristics

Of these eight schools, 4 were low decile (deciles 1-3), 2 were mid-decile (4-6), and 2 were high decile (8-10), and no schools were from decile 7. Six schools were contributing primary schools, serving new entrants through year 6, and two were full primary schools, serving children through year 8. The low decile schools served approximately 1199 children, the mid-decile schools about 1055 children and the high-decile schools about 1138 children per year.

Pre-EQ Participant Recruitment

Participants in the Pre-Earthquake group were recruited as children turned five years of age and entered one of the study schools over seven school terms. In NZ, children enter school on their fifth birthday or the next school day, if their birthday falls during a weekend or holiday (staggered entry dates). Children are usually enroled in school by their parents prior to their fifth birthday, so that children can attend some school visit days before their actual first day. Some children are enroled on the first school day they are eligible to attend. New enrolees are usually interviewed by the principal or deputy principal, and the required enrolment information is collected. During the enrolment meeting at participating schools, parents/carers were invited to participate in the study. Parents of children who agreed to be contacted after talking with the principal or teacher at school entry had the study explained to them by trained research assistants. Of these parents, 93.7% gave informed consent for themselves and their child to participate in the study (Liberty, Pattemore, Reid & Tarren-Sweeney, 2010).

Inclusion Criteria

Children entering participating schools at age five or the next school day after their fifth birthday during the recruitment period whose parents gave informed consent were included. Children who entered school with a diagnosed disability requiring special education support, or whose first language was not English or Māori (official languages of New Zealand) were

excluded in the original recruitment, with the exception of one child who was diagnosed with a significant disability during the first school term and their data were excluded from the analysis (N=297).

EQ- Exposed Group

Schools

A purposive sampling procedure was used to recruit schools and participants in the EQ-exposed group, similar to that used by Bal (2008) and Moore and Varela (2010). Invitations to participate in the study were sent to primary schools from neighbourhoods highly affected by the EQ in the south and east side of Christchurch, and five schools consented. Of the eight schools in the Pre-EQ study, six were, by random chance, in the parts of the city later most strongly affected by the EQ. Of these six schools, all declined or did not respond to the invitation to participate in the Juniors Study post-earthquake. Of these six schools, three were closed or merged into other schools as a result of the earthquake and the principals of two other schools changed.

The recruitment was affected as, during the same week that the recruitment notices was circulated in 2012, the Minister of Education announced changes to Christchurch Schools (Figure 3.1).

School Characteristics

Five schools agreed to participate. All schools had buildings that were damaged in the earthquakes, and some schools had ongoing repairs. Of these five schools, in 2013, one was low decile (deciles 1-3), two were mid-decile (4-5), one was high decile (8-10), and one was decile 7. Two schools were contributing primary schools, serving new entrants through year 6, and three were full primary schools, including children through year 8. The low decile school served approximately 170 children, the mid-decile schools about 788 children and the decile 7-10 schools about 910 children per year.

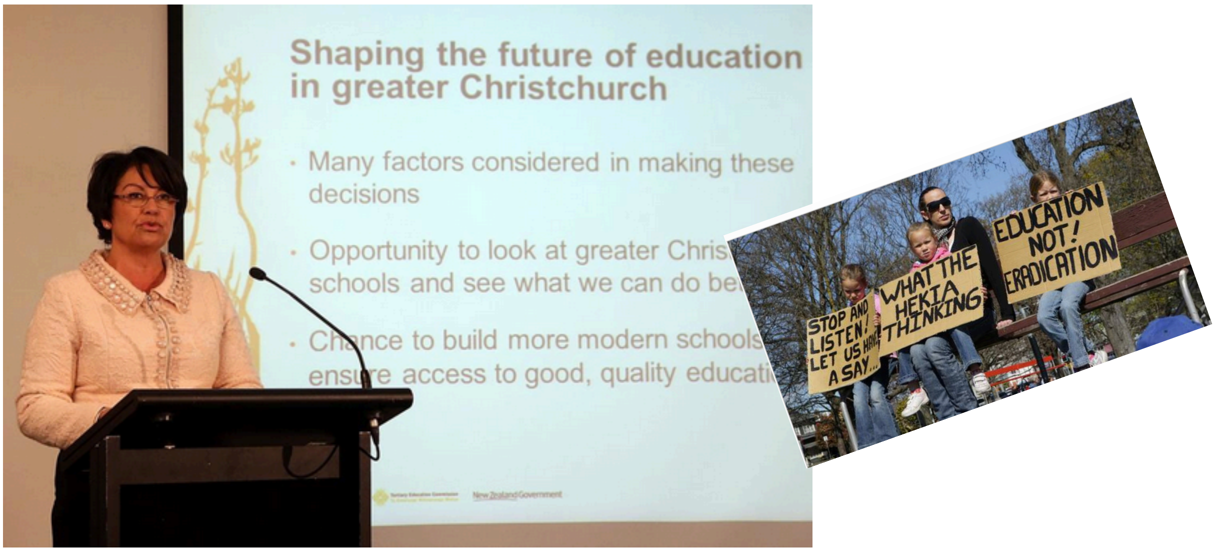

Figure 3.1. The Minister of Education and protestors. (Photo credits: Stuff, http://www.stuff.co.nz/the-press/news/schools/8731144/19-schools-hear-their-fate; http://www.stuff.co.nz/national/education/94016060/editorial-counting-the-cost-of-a-bureaucratic-experiment).

Inclusion Criteria

The same inclusion criteria used for the Pre-EQ study were used for children in the Juniors study, with the additional requirement of being present during the earthquake exposure period, as defined for the study.

Earthquake Exposure Period

The earthquake exposure period was identified as beginning on 4 September 2010, with a magnitude (M) 7.2 earthquake and continuing until the largest earthquake prior to recruitment of schools for the study, an M5.0, on 12 January 2012, including 120 EQ of $\geq$M5.0, a total exposure period of 17.2 months. The exposure period continued through to school entry at age five years and thus included exposure to the post-disaster events.

EQ-Group Participant Recruitment

Teachers in the study schools approached parents/carers with approved information sheets and consent forms or sent these home with the child, with an estimated recruitment rate of 65% of those meeting the inclusion criteria. Children were recruited by their teachers during 2013, although this included some children who entered school late in 2012 and were considered to be in the new entrant group. Recruitment continued in 2014 and through Term 4

of 2015. Of the 322 children for whom consent was received, 308 lived in Christchurch during the exposure period and to school entry and met the inclusion criteria.

Clarification of the Experiences of the EQ-Exposed Group

The Pre-EQ Group were children exposed to the normal types of stressors in any environment and also to the types of traumatic events that can affect families in any community (see Chapter 1). These children were recruited into a study of the relationship between health and learning from 8 randomly selected schools, as described.

The second group, the EQ-Exposed group, were exposed to the earthquakes from the time they were younger than 42 months and up until the start of school. By nature of the earthquakes, the children (and their families) were also exposed to the numerous types of stressors that accompany earthquakes – injury and exposure to death, damage to homes, and the consequent longer-term events, such as moving, parental job loss, insurance issues, and so forth. During this same time period, they were also exposed to the normal types of stressors in any environment and the types of traumatic events that can affect families in any community. Thus, the term "EQ-Exposed" includes all of the disaster and post-disaster phases. There is no way that the present study can discriminate between the effects of EQ-Exposure and exposure to all of the subsequent earthquakes and post-earthquake phases.

Measurement and Procedures

As part of the pre-earthquake study, teachers reported on children's problem and positive behaviours, their competence, attendance, and natrional standards. Parents reported on children's positive behaviours and health. To have a firm basis for comparison, measures that were used in the Pre-Earthquake study were also used in the Juniors Study. Additional measures of earthquake exposure were also used.

Demographic Variables

Information on gender and ethnicity was gathered from school records with parent consent. Parents provided child birthdate and home address. Family socio-economic status was estimated from an NZ Deprivation Decile Score (Akinson, Salmond, Crampton, 2014; Salmond & Crampton, 2012; Salmond, Crampton, King & Waldegrave, 2006) determined for each participant's address. This score is based on ten socioeconomic variables collected during the national census, including family income, income source, home ownership, employment, qualifications, and so forth, collected in a small neighbourhood area during the

national census. Researchers can access these data coded to specific dwellings by address, giving a quantitative summary of a neighbourhood. Data from the 2006 census was used for addresses for the Pre-EQ group and from the 2013 census for the EQ-Exposed group. Decile scores, ranging from 1-10, were assigned to each family, and categorized as follows; deciles 1-3 representing high SES (low deprivation), deciles 4-7 representing mid-SES and deciles 8-10 representing low SES (high deprivation).

Earthquake Exposure (EQ-Exposed Group Only)

Parents reported earthquake exposure during recruitment, using approved consent forms. Items addressed child living situation on the day of the first earthquake (e.g., living with both biological parents, living with one biological parent, etc., using items from the NZ Census). The next set of items reported the child's presence in Christchurch for earthquakes on 4 September 2010, 22 February 2011, 13 June 2011 and 23 December 2011, whether they with at least one parent or not, whether they were at preschool (and the name of the preschool) or if they were out of Christchurch.

Parents also reported on items identified from previous studies as contributing to the development of post-disaster symptoms. The frequency of children experiencing these events was determined. These items were:

- *The child was injured.*
- *Someone the child knew was injured or died*
- *The house the child lived in was damaged.*
- *The child experienced objects falling off shelves or cupboard doors opening and contents falling onto the floor*
- *The child was in a location that experienced loss of electricity, water, telephone.*
- *Child spent time in a shelter (with or without parents)*
- *Child used a portaloo for more than one month.*
- *Child stayed out of the earthquake area for one month or more.*
- *Child's preschool was closed for one month or more.*
- *Child had to change preschools.*
- *The family moved house (and the number of times).*
- *Friends of child moved away.*
- *Local playground was damaged or closed for one month or more.*

- *Relatives or friends came to stay in the same house for one month or more.*
- *Change to where the child slept for one month or more.*
- *Child and/or family received counselling.*
- *Parents/Family experienced high levels of stress*.

Information on these items was collected from a postal questionnaire. Parents also were able to add anecdotal information about their experiences in response to open-ended questions about their experiences on either the consent form or the postal questionnaire.

Land Damage (EQ-Exposed Group Only)

The CERA rated earthquake land damage for each participant's address was also determined using a government website (i.e., on http://cera.govt.nz/my-property), as this has been shown to be an exposure factor significantly associated with mental health problems in EQ-exposed families (Hogg et al., 2014). These codes indicate the level of damage to the land and are illustrated in Figure 2.2, with Red Zone (RZ), Technical Category 3 (TC3), Technical Category 2 (TC2), and Technical Category 1 (TC1) indicating descending levels of damage. No EQ- Exposed Group participants were living in the red zone at the time of the study recruitment. However, proportions of the Pre-EQ study participants neighbourhoods and school zones were in areas designated as Red Zone following the earthquakes.

Child Health Problems

Items relating to child health from the National Health Interview Survey (NHIS) were used in the Pre-Earthquake study and were administered by parent interview. As funding was not available for parent interviews, for the EQ-exposed group, only somatic items have been identified with child post-traumatic stress symptoms in a disaster community (Fergusson, Horwood, Boden, & Mulder, 2014; Sun et al., 2014; Zhang, Zhu, Du, & Zhang, 2015) were used to assess parent-reported child health, using a postal questionnaire. Parents were asked if their child had experienced any of the following health problems in the past year: *trouble going to sleep; nightmares; waking in the middle of the night; changes in eating or eating problems; headaches; stomach aches; wet or soiled the bed; ear infection; speech or language problem or asthma.* An additional item was added: *fear of sleeping alone*. If the parents responded 'yes', they were asked to identify if the problem had occurred in the previous three months.

Figure 3.2. Rockfall at Redcliffs, resulting in deaths and destruction of homes. Photograph taken five days after the 22 February earthquake. Photograph from*The Encyclopedia of New Zealand* (2015, https://teara.govt.nz/en/photograph/46381/rock-fall-at-redcliffs-2011. Redcliffs School (not a study school) is in the centre of this photo.

Behaviour Problems

Behaviour problems were measured by teacher report using the *Behavior Problems Index (BPI*). This is a freely available measure of behaviour problems in children, which currently may be downloaded from this source (https://www.nlsinfo.org/content/cohorts/nlsy79-children/other-documentation/codebook-supplement/appendix-d-behavior-problems). The BPI has been used in longitudinal studies in the United States since the 1990s (Byrd, Weitzman & Auinger, 1997; National Longitudinal Surveys, n.d.; PSID, 2017; Peterson & Zill, 1986; Rodgers et al., 2017). It is based on an early version of the Child Behavior Checklist (CBCL; Achenbach & Ruffle, 2000; Zill, 1985). However, it is more suitable for use the New Zealand studies, because it has 26 items as compared with more than 80 items on the CBCL, which reduces the amount of time that teachers need to complete it, because of similar psychometrics, and because it is free. Teachers had no difficulty scoring or understanding the BPI. The Boards of Trustees of the school also approved the BPI before consenting to participate.

Teachers rated each child on the 26 BPI items using a 3-point Likert scale (0=not true, 1=sometimes true, 2=often true). Item scores may be treated in two different ways. First, item

scores may be summed, with higher scores indicating more behavioural difficulties, with a possible range of 0 to 52 (i.e., trichotomous scoring). A second scoring method is based on dichotomising scores, such that item ratings of 'sometimes' or 'frequently' are scored as "1" and ratings of 'never' are scored as 0, yielding a possible range of 0-26. Normative standard scores based on the large-scale longitudinal study conducted in the USA are available for children of different ages (National Longitudinal Studies, n.d., *c*).

According to the US BPI age-standard norms (National Longitudinal Surveys (n.d.*c*), about 25% of children will have a score of zero at ages 5 through 8 years, although five year old children are not in primary school in the USA at age five. While a score of zero might be considered optimal, it is normal for children to occasionally have one or two problems, and so scores of 1-2 are not particularly concerning, and represent below average BPI scores. Scores in the range of 3-7 can be considered to represent the norm in US children. Scores up to 14 represent scores that are within one standard deviation of the average in terms of behaviour problems in US samples. A raw score of 15+ on the BPI has been identified as a cut-off score for referral for diagnostic purposes, when the BPI is used as a screening instrument, and represents one standard deviation above the mean in regards to higher BPI scores in both dichotomous and trichotomous scoring (National Longitudinal Studies, n.d., *b).*

However, the score itself may not be an indication of actual impairment or the problems following on, because even one behaviour problem, such as crying or being angry, can severely impair a child's ability to settle in and learn at school.

Post-traumatic Stress Symptoms

The most commonly used screening measures for PTSD, such as the UCLA PTSD Reaction Index; Child PTSD Symptom Scale; Posttraumatic Stress Symptoms in Children and the Trauma Symptom Checklist for Children are not suitable for children under the age of 6 years (Shaw, Espinel & Schultz, 2012). Children under the age of 6 years are not able to self-report on their symptoms. Difficulties with measuring the symptoms of PTS in children under the age of six years are associated with their relative developmental immaturity, their limited communicative competence in understanding their own emotions, the lack of development of executive function needed to differentiate thoughts from emotions and memories from present events, and so forth (Cloitre, Stolback, Herman, Kolk et al., 2009; Masten & Narayan, 2012; Sameroff & Haith, 1996; Scheeringa, Zeanah & Cohen, 2011; Scheeringa, 2008). This difference has been recognised in continuing examination and consideration of how PTS

symptoms are expressed in the behaviour of young children, and as represented in the introduction of new diagnostic criteria for PTSD in children, with a separate set of criteria for children aged six and younger, introduced in the *Diagnostic and Statistical Manual, 5th Edition, (DSM-5*) by the American Psychiatric Association in 2013.

The characteristics of PTSD are set out in the fifth edition (2013) of the *Diagnostic and Statistical Manual of the American Psychiatric Association* (DSM-5) and require the child to be individually evaluated by specially trained mental health professionals. However, in a post-disaster community, highly trained professionals are needed to deliver mental health services and are usually not available to individually evaluate 300+ children for PTSD in a community study. Instead, researchers in disaster-struck communities have commonly used standard screening type instruments to estimate symptoms (e.g., Osofsky et al., 2015).

Although it would be ideal to have children individually assessed by mental health experts, in post-disaster communities, mental health experts are typically overwhelmed, and this has been the case in Canterbury. Thus, like many other studies, children's PTS symptoms are estimated by parent and teacher report and no diagnosis is made.

Respondents in studies of PTSS in young children are typically the child's parent or main caregiver. However, teachers may be more reliable reporters of children's behaviour including PTSS (Chemtob, Nomura, Rajendran, Yehuda, Schwartiz & Abramovitz, 2010; Enlow, Blood & Egeland, 2013; Koiko & Kazdin, 1993; Thabet & Vostanis, 2000; Widyatmoko, Tan, Seyle, Mayawaati & Silver, 2011), because they can report more conservatively on children's symptoms, possibly due to the fact that they have a far wider experience-base of typical and atypical behaviours as compared to parents, or might have less bias (Maoz, Goldstein, Goldstein, Axelson et al., 2014). For example, the PTSS of 138 three- to five-year-old children exposed to a traumatic event were rated by parents and teachers: significantly, parents rated irritability in 29% of the children as compared to 7.1% rated by teachers; similarly, clingy behaviour was rated in 46.7% of children by parents as compared to 7.2% by teachers (Graham-Bermann & Seng, 2005). For this reason, many post-EQ studies use teacher reports.(e.g., Eksi, & Braun, 2009; Usami, Iwadare, Watanabe et al., 2014).

For the present study, a screening-type subscale for PTSS in young children was constructed from teacher-reported BPI items matched to the CBCL PTSD subscale items suitable for children aged 6 and younger, as described by Dehon and Scheeringa (2006). Of the 15 preschool items on the CBCL PTSD sub-scale, six are by parent report and these were not

included in PTS- teacher-report used in the present study (i.e., nightmares; fears animals, situations or places; nausea and feels sick; stomach aches and cramps without medical cause; vomiting and throwing up without medical causes; wakes up often at night). As the children were five years of age at the time of the first measure, but the study was planned to be longitudinal, one item from the CBCL scale for children older than six was identified by Dehon and Scheeringa (2006) as associated with PTS and this item was added to the subscale: 'cannot get his/her mind off certain thoughts, obsesses' to comprise 10 items. The teachers were blind as to which of the 26 items included on the BPI checklist were associated with PTSS. Teacher ratings were dichotomised, with items marked 'sometimes true; and 'often true' scored as "1" and items marked 'not true' scored as 0, yielding a possible range of 0-10 on the PTSS subscale. Dehon and Scheeringa (2006) established a cut-off score of 9 of 15 (56%) as providing sufficient specificity and sensitivity. Although the purpose of the present study was not to diagnose children, and diagnostic interviews were not conducted, a pro-rated cut-off of 6 of 10 was used to identify children with high symptom scores.

To provide a limited estimate of the validity of the PTSS score in the EQ-exposed group from the constructed sub-scale, symptoms were matched as best as possible to the diagnostic criteria for PTSD in Children 6 and younger from the 5th Edition Diagnostic and Statistical Manual of the American Psychiatric Association (APA, 2013). All children in the EQ-exposed group were considered to have met Criterion A, experiencing a traumatic event, due to the study inclusion criteria. Four items were related to Criterion B, representing symptoms or behaviours associated with re-experiencing or intrusive thoughts: (i.e., *clings or too dependent*; *sudden changes in mood*; *too fearful, anxious, cannot get mind off certain thoughts*). Two items represented Criterion C, avoidance, numbing, and alterations in mood (i.e*., unhappy, sad, depressed*; *withdrawn, not get involved with others)*. Four items were matched to Criterion D, arousal (i.e., *irritable, or strong temper, loses it easily*; *difficulty concentrating; nervous, high strung, tense*; *argues a lot, disobedient/defiant*). Scores that included one each of Criteria B and C, and two of Criterion D, were defined as indicative of high PTSS. However, as all items associated with the DSM-5 preschool PTSD symptoms were not included in the teacher report used in the present study, this comparison has been used as indicative of the validity of the PTSS score cut-off in the present study. This approach to estimating symptoms of post-traumatic stress was approved by a peer-review process (Liberty et al., 2016).

Self-Regulated Behaviour

Two scales were used to measure self-regulation. *The Positive Behaviors Scale* (PBS), which has been used in major longitudinal studies of children and youth, was used to assess items related to self-regulation of behaviours and emotion (Epps, Park, Huston & Ripke, 2003, 2005; PSID, 2010; Quint, Bos & Polit, 1997). This scale has ten items that are rated on a 5-point Likert scale (1= not at all like this child, 2 = not like this child, 3= neutral, neither like nor not like this child; 4= like this child and 5= very much like this child). The behaviours may be grouped into categories associated with behavioural inhibition (e.g., *waits turn in games or other activities, usually complies with directions*), emotional regulation (e.g., can get over minor upsets quickly), and curiosity and initiative (e.g., "likes new experiences"). Items are summed for a total score and divided by the number of items (10) to produce a mean item score for each child. The 10-item scale has good internal consistency (Cronbach's alpha = 0.79). The PSID (2010) reported that the mean total score derived from parent reports was 4.23 (SD=0.56) over 2, 777 children's reports.

Children were also rated on six items adapted from the *Child Behavior Checklist Competence Scales* (Achenbach & Rescorla, 2001), which include children's competence at basic academic skills, communication, and school behaviour. These items were rated on a 5-point Likert scale (0-4) in which the teacher rated their expectation for the child's performance at the start of the academic school year, and then the child's actual performance at the end of the academic school year. The teacher rated the child in comparison with other children in the same classroom, with higher scores indicating higher teacher-rated expectation at the beginning of the school year and competence at the end of the school year.

Academic Performance and Attendance

New Zealand has a national school progress assessment programme, which sets expected progress within the national curriculum (Ministry of Education, 2010). Children's reading, math, and writing are judged against national standards according to weeks of school attendance (NB. 40 weeks is considered the length of one academic school year). Children's learning is categorized as "at the standard", above or below the standard (approximately one year equivalent), or "well below the standard" (more than one year below). According to the Ministry of Education, children who are rated as below or well below would be expected to receive additional support for learning (Ministry of Education, n.d.). For the present study,

teachers or deputy principals completed a report form on the child's progress against the national standards on an annual basis. Teachers also reported on child attendance.

Procedures and Data Analysis

Post-traumatic stress symptoms and self-regulation and their associations with demographic variables in both groups were the focus of this study. Teachers completed the BPI, PBS and CBCL Expectation for Learning scales as the children entered the study (i.e., within 3 school weeks of when teachers received signed consent forms from the parents). This comprised Time 1 in both the Pre-EQ and EQ-Exposed groups. In the Pre-EQ group, Time 1 measures also included the demographic and child health information from parents. Teacher reports were repeated after one year. In the EQ-Exposed group, during the child's first year in the study, parents were asked to complete the Exposure, Child Health and Positive Behaviour Scale via a postal questionnaire. Parents received a small gift voucher for their time. In the EQ-Exposed Group, the teachers reported again at the end of the children's first academic school year. In subsequent years, teachers reported within three weeks of the beginning and end of each school year. Information on attendance and national standards was collected once per year.

Data were entered into SPSS for summarisation and analysis. Data analysis included various statistical procedures depending on the purpose or question being addressed. For example, means and standard deviations for scores on the BPI were calculated to indicate population characteristics at different time points. However, to provide additional information, BPI scores were categorized according to score ranges, and the frequency of children whose scores fell within each category was reported. In technical reports, odds ratios were used to examine relationships between PTSS and demographic characteristics. Multivariate logistic regression analyses were performed to examine independent associations between key demographic variables and high PTSS scores. SES was dichotomised as low SES v. all else and ethnicity was dichotomised as European v. all else. All data summarisation and analyses were conducted using the Statistical Program for Social Sciences, version 21. Data analysis is ongoing, and not all analyses have been completed or are included in this report.

Quality Assurance Processes

In establishing the study and gaining ethical consent, discussions were held with lead principals about the procedures that were necessary to add value to their practice. Principals wanted assurance that the data collected would be fed back to them as quickly as possible,

and they also wanted to know how the data from their school compared with the other schools. These procedures were incorporated into the approved ethical procedures for the study.

The data on children's behaviour, posttraumatic stress, and arousal, in total and by year-cohort, were reported to each principal in a written report. The report gave results for their school, and also results for the study schools as a whole (inclusive). A meeting with the principal and senior management team in Term 1 of each study year was held to discuss the report each year. The principal/senior management team discussed the data on their school, and whether the data, collected on the study group sample, was representative of their entire school. The data was confirmed at each meeting, although at times the principals' reported that in some classrooms the data seemed to under-represent the problems, but, overall, the data were confirmed. Thus, from the point of view of the 'consumer' of the data, the data from the study sample was representative of the pupils attending the school as a whole.

Stephen Woolf, Jason Purnell, and their colleagues from Virginia Commonwealth University and Washington University in St. Louis have reviewed strategies and barriers to translating evidence into practice (2015). In order to set the stage for translation research, investigators must (a) ensure they provide information that meets the priorities of the decision-makers (b) present the findings in a form that is relevant and useful to the decision-makers, remembering that decision-makers are very likely to be non-scientists who do not have the time or resources to read scientific journals (c) engage the decision-makers in discussions of the information and its relevance, and (d) communicate in an effective and strategic manner that recognises the reality of school situations.

Recommendations to Accelerate Transfer of Research to Practice for Researchers

. . . .Involve the target audience or "end consumers" and program providers in formative assessments and intervention design from the outset to enhance reach, adherence, adoption, implementation, and maintenance.

Russell Glasgow, Lisa Klesges, David Dzewaltowski, Sheanna Bull and Paul Estabrooks, 2004) p. 8.

Chapter 4
The Effects of Earthquake Exposure at School Entry

The initial aim of the Juniors Study was to determine if the children who entered school following exposure to the Christchurch earthquakes had measurably different behaviour, as compared to a group of children who started school before the earthquake period. In this chapter, the results of these comparisons are examined.

Study Results

Demographic Comparisons

The first step was to determine if there were differences between the Pre-EQ and the EQ-Exposed groups on factors other than the exposure to the earthquakes, including the proportion of children who were girls, who were living in deprived neighbourhoods, or who were Māori, as the risk factors for PTSD include female gender, poverty, and minority ethnicity, as previously described.

The numerical comparisons of the two groups are shown in Table 4.1. The additional ethnicities reported in the EQ-Exposed group included: 3.3% Asian, 2.9% Pacific Island, and 1.6% other, as compared with 3.0%, 4.7% and 1.7%, respectively, in the Pre-EQ group, although the numbers of children in these groups were too small for meaningful statistical analyses. Comparisons of the two groups showed there were no statistically significant differences between the groups in gender (Chi square= .863, p=.35, *ns*) or the proportions of European or Māori ethnicity (Chi square=2.69, p=.75), and all of the children were five years of age when they started school.

Table 4.1. Characteristics of the Study Groups at Study Entrance

Characteristics	**Study Groups**	
	Pre-EQ	**EQ-Exposed**
Number of Children	297	308
Year of Birth	2000-2002	2007-2011
Attended Preschool	100%	100%
Year Started School (range)	2005 -2007	2012 -2015
Gender		
Boys	49.2%	54%
Girls	51%	46%
Ethnicity		
European	75%	74.8%
Māori	15.8%	17.3%
Child Living Situation		
living with both biological parents	77.8%	89.5% (a) 82.1% (b)
Neighbourhood Deprivation		
Low	21.5%	30.8%**
Mid	41.1%	38.0%
High	37.0%	30.0%*
School Decile		
Low (1-3)	36.7%	23.2%**
Mid (4-6)	28.6%	38.2%
High (7-10)	34.7%	38.6%

*p>.05; **p>.01

(a) Living situation prior to 4 September 2010 Earthquake as reported at time of Exposure Report (N=238). (b) Living situations reported at time of Exposure Report (N=233).

Significant Differences

However, there was a set of significant differences in the demographic factors. The Pre-EQ group had significantly fewer children living with both biological parents as compared to the EQ-Exposed group (Chi-square = 13.912, p>.001). The EQ-Exposed Group had significantly fewer children from neighbourhoods designated as high deprivation in the NZ census (Chi-square = 6.85, p=.03) and significantly fewer children attending a low decile school (Chi-square= 13.78, p=.001). The EQ-Exposed group also had significantly more children from low deprivation, high socioeconomic status neighbourhoods (Chi-square = 6.743, p =.009).

Discussion of Group Differences

This difference is not surprising, as many homes and schools in high deprivation neighbourhoods were significantly damaged during the earthquakes, and subsequently torn

down or closed. Many neighbourhoods that included children in the pre-EQ study were classified in the red zone, and this reduced the number of homes that had formerly been considered high deprivation neighbourhoods.

The significant differences between the two study groups in the proportion of children living in high deprivation-classified neighbourhoods, attending low decile schools, and not living with two biological parents are important in the context of this study. This is because children from poor communities or living with a solo parent have a higher risk of developing PTS symptoms following a natural disaster (Foa, Stein & McFarlane, 2006; Shaw, Espinel & Schultz, 2012). Because the EQ-Exposed study group had proportionally fewer children with these risk factors as compared to the Pre-EQ study group, this meant the present study was more likely to underestimate PTS prevalence in the community.

Comparison with Overall Population

Between the 2006 census and the 2013 census, Christchurch lost 2% of its overall population. The largest losses (upwards of 40%) were experienced in the eastern parts of the city, the parts of the city most affected by the earthquakes (Statistics New Zealand, 2015), and also the parts of the city from which the majority of both study groups was drawn.

Figure 4.1. A boy in distress. (The photograph is royalty free and used with permission from

Regarding cultural or ethnic identity, 83.9% of the respondents to the 2013 census identified as European, 7.9% as Asian (6.7% in 2002), 2.6% as Pacific Island (2.4% in 2006). In addition, between the 2006 and 2013 census, the number of Māori living in the wider Christchurch area increased by 12%, to 8.2% (Statistics New Zealand, 2015). In comparison, both study groups had significantly more Māori children and fewer European and Asian children as compared with the city as a whole.

However, overall in New Zealand, 74% of people identify as European and 15% as Māori. Thus, the demographics in both samples in terms of cultural and/or ethnic identity are equivalent to the demographics of the country as a whole.

Parent-Reported Exposure to Earthquake-Related Events

The next important point is to confirm that the recruitment of the EQ-Exposed group met the inclusion criteria, and also therefore met the first criterion for PTSD according to the DSM-5, which is experiencing a traumatic event.

According to the parents of children in the Juniors Study, all of the children were present in Christchurch for the major series of earthquakes identified as the primary exposure period. They continued living in Christchurch through to beginning primary school, and then continuing through the study measures, except for short holiday periods. All of the participants had long-term chronic exposure to the earthquakes and the post-disaster stressors. Therefore, all study children met the first criterion for a post-traumatic stress disorder.

As the children started school on their fifth birthday, and as children were recruited into the study over three years, children were different ages at the time of the September 4 2010 earthquake, and had variable exposure durations by the time that they entered the study and teachers first reported on their behaviour (Table 4.2). These ages are significantly different from each other (F=225.629, p>.001), as are the duration of exposure (F= 203.477, p>.001). However, although there are slight differences in the age at which children in each year cohort started school, these are not significant (p=.07, ns).

Table 4.2. Age at Start of Exposure Period, Duration of Exposure to First Teacher Report and Age at School Start in the EQ-Exposed Group.

Year Cohort Year Started School	**Months of Age at 4 September EQ**	**Months Duration of Exposure to School Start**	**Age in Months at School Start**
	Mean (SD)	Mean (SD)	Mean (SD)
2012 (N=20)[1]	35.8 (1.9)	23.65 (1.9)	60.0 (0.2)
2013 (N=116)	27.6 (4.2)	32.1 (3.7)	60.3 (1.4)
2014 (N=100)	14.7 (3.2)	43.2 (8.7)	58.7 (8.5)
2015 (N=70)	2.8 (13.2)	53.6 (7.6)	57.0 (14.1)

[1] Although it was not planned to recruit children who started school in 2012, these children were identified as New Entrants at the start of school in 2012, and thus were recruited by teachers into the study.

Parents reported on additional known factors related to the seriousness of exposure: 1.7% of the study children were themselves injured, and 9.7% knew someone who was injured or died. Also, 66.1% of the children lived in a house that was damaged 94.9% of the children experienced loss of services, water, electricity, and phone; and almost 50.2% of the families reported they experienced high levels of stress. Overall, the mean exposure score was 6.55 (range 0-15). The exposure score was positively correlated with the number of sleep problems reported by parents ($p>.001$).

According to the Land Damage Classification categories, 17% had homes with TC3 (severe land damage) classifications, 77.8% had homes with TC2 (moderate land damage) classification, and 5% had homes with an unknown classification (social welfare homes). No participants had homes with the TC1 classification.

All of these are very important indicators of the severity of exposure to recognised disaster-related stressors.

The study questionnaire asked whether the children experienced objects falling off shelves or cupboard doors opening and contents falling on the floor during the earthquakes. 83.1% of the children experienced this. Why is this important? Because during this period of their development, when the study children were younger than four years of age, the child is developing their conception of the world, according to Piaget's theory of cognitive development (Piaget, 1951). Instead of experiencing object permanence, for example, in the world that these children experienced, objects were not permanent at all. Objects could inexplicably fly off the walls. Noise could suddenly fill the room, and the walls and floors would move. Lights could go out or come on, or swing wildly from the ceiling. Water would have to be boiled or you could drink it from the tap. Parents tried to explain things to them that were beyond the view of the world that they had. This was a unique risk factor evaluated in this study and contributed to understanding of the origin of some symptomatic behaviours.

Research indicates that exposure to traumatic events and post- disastor stressors during a sensitive developmental period is related to the presence of behaviour problems. This is examined in the next section.

Comparison of Behaviour Problems

BPI collected as the child began the project from teacher reports was used to examine the extent or prevalence of behaviour problems.

In the Pre-Earthquake Group, 5.1% had a score of 15 or more on the behaviour problem scale (Table 4.3). By comparison, 10.5% of the earthquake-exposed children who entered the Study Schools scored in this highest score category. However, both groups had more children with 0 behaviour problems than reported in the US Norms (National Longitudinal Study, 2017b), although there were proportionally more than in the Pre-EQ group. The number of children with zero or low behaviour problems is important because these children can also be role models for children struggling to settle in schools. The differences in the distribution of the scores was significant (Chi-square = 14.02, p=.007).

Table 4.3. Behaviour Problem Index Score Category at the Start of School (Age 5 years) Comparison Across Groups

BPI Score	**Group**	
	Pre-EQ (N=297)	EQ-Exposed (N=308)
0	35.7%	31.0%
1-2	19.5%	22.0%
3-7	28.3%	23.5%
8-14	11.1%	12.7%
15+	5.1%	10.5%
Mean Score (S.D.)	3.85 (5.5)	4.97 (6.8)*

*p=.02

On average, each child in the EQ-Exposed group had one more behaviour problem than the group that had entered school before the earthquakes. This is a statistically significant difference. This is a difference with huge practical significance. It indicates that for every classroom with children exposed to the earthquakes when they were younger than four years of age, there might be 30 more behaviour problems in a class of 30 children, which is very likely to increase teacher stress. It also illustrates that the context of the environment in which children are expected to settle and begin learning was very different between the Pre-EQ and EQ-Exposed groups.

Comparison of Post-Traumatic Stress Symptoms

As the most common psychological outcome of experiencing a traumatic event such as a natural disaster is post-traumatic stress, the next comparison was the presence of post-traumatic stress symptoms in the study groups. The results for Post-Traumatic Stress Symptoms are shown in Table 4.4, and confirm that significantly more EQ-exposed children had symptoms as compared to the Pre-EQ group, whose symptom rate is that normally expected in a general population.

Table 4.4. Post-traumatic Stress Symptoms in Study Children at School Start

Post Traumatic Stress Score	**Groups**	
	Pre-EQ	**EQ-Exposed**
No PTS Symptoms	40.4%	32%
High (6+) PTS symptoms	8.8%	19.3%
Mean PTS Score (S.D.)	1.96 (2.9)	2.7 (2.9)**

p=.0018

The rate for the Pre-EQ baseline group with high symptoms was 8.8% at the start of school. In the EQ-Exposed group, about 19% had high numbers of PTS symptoms, more than twice as many as the Pre-EQ group. It is sufficient to say that the levels of post-traumatic symptoms in the EQ-Exposed study group were alarming, and were statistically significantly higher than in the pre-EQ group. Overall, taking into consideration the proportion of children who did not have any teacher-reported symptoms of PTS, 68% of children in the study schools had one or more symptoms.

The next comparison was to determine if there were differences in the year cohorts in PTS symptoms. Although the values for the mean PTS score vary across age cohorts as shown in Table 4.5, the overall pattern of mean PTS does not indicate a significant difference (F= 1.688, p=.167).

Table 4.5. Post-traumatic Stress Symptoms at the Start of School in EQ-Exposed Study Children by Year Cohort.

Post Traumatic Stress Score	Year Cohorts			
	2012 (N=20)	2013 (N=116)	2014 (N=100)	2015 (N=70)
No PTS Symptoms	30%	28.4%	31.0%	40.0%
High (6+) PTS symptoms	10%	19.0%	23.0%	15.7%
Mean PTS Score (S.D.)	2.05 (2.2)	2.8 (2.8)	3.1 (3.1)	2.3 (2.7)
Mean Age in Months (SD) at Start of Exposure Period	35.7 (1.9)	27.6 (4.2)	14.7 (3.2)	2.0(13.2)

Comparison of Arousal and Reactivity Symptoms

Specific behaviours cause stress for teachers and parents, and these are the behaviours associated with one of the symptom classifications for the diagnosis of post-traumatic stress disorder–arousal and reactivity.

Arousal and Reactivity

- *over-quick to perceive something as a threat*
- *hypervigilance*
- *sleep problems*
- *reactive and negative reactions to new events*
- *irritable, argumentative, aggressive*
- *risky or self-destructive*
- *easily lose strong temper*
- *difficulty concentrating.*

Hyperarousal is a term that is used by psychiatrists to indicate a dysregulated autonomic system that is over-quick to perceive something as a threat, to react quickly and usually negatively to new events and is expressed in children in behaviours of being irritable, arguing a lot, being disobedient and/or defiant, having a strong temper and losing it easily, being high-strung, nervous, tense and, related to all of these, having difficulty concentrating. Arousal has also been singled out in research studies for its importance in understanding young children's mental health (e.g., Scheeringa et al., 2005).

The behaviours that are associated with arousal and reactivity are the ones that are normally most concerning to teachers in a classroom situation. They create unease and fear in the other children and a disharmonious classroom. They make it difficult for these children to make friends and to have decent and positive social relationships.

Two symptoms of arousal and reactivity are required as one of the core criteria for a psychiatric diagnosis of child PTSD, according to the *Diagnostic and Statistical Manual*, fifth edition, of the American Psychiatric Association (2013). These symptoms should either first

appear or worsen following the trauma exposure. However, as the children in the study were younger than 41 months, and many were younger than 24 months, it would not be expected that such behaviours would have been identified in such young children. Although it is possible that some study children might have had pre-existing traumatic exposure or other conditions associated with arousal prior to the extended earthquake period, such as impacted the Pre-EQ group.

For purposes of understanding the children's behaviour at school, however, it is not essential to prove what caused the arousal and reactivity – it is enough to demonstrate its presence. Even one symptom of arousal and reactivity, such as anger, can be very disrupting to the child's ability to settle in and learn at school.

"Children with significant PTSD symptoms who do not meet full criteria for a PTSD diagnosis often have comparable functional impairment to those with a PTSD diagnosis."

American Academy of Child and Adolescent Psychiatry Official Action on PTSD (2010, p. 415).

Four items of the *Behavior Problem Index* were matched to the DSM-5 criteria for arousal and reactivity, as explained above. If a child had two or more of these items reported by a teacher as occurring sometimes or often, the child's score met the DSM-5 Criteria for arousal.

Table 4.6. Arousal and Reactivity Symptoms in EQ-Exposed Study Children

Arousal Items	**Groups**	
	Pre-EQ	**EQ-Exposed**
No Arousal symptoms	46%	41%
1 Arousal symptom	23%	18.5%
2 + Arousal symptoms	31%	40.5%
Mean Arousal Score (S.D.)	1.06 (1.23)	1.67 (2.00)**

**p>.0001

As shown in Table 4.6, more children had arousal symptoms in the EQ-Exposed group, and the mean score of arousal items was significantly larger. For comparison purposes, Scheeringa, Zeanah, Myers and Putnam (2005) reported that, 28 months after experiencing traumatic events, 51.4% of children aged from 20 months to 6 years had hyperarousal symptoms. Thus, although the traumatic events differed between the studies, and the age

ranges of the children in the two studies were different, the prevalence of arousal symptoms was similar, as 59% of the children in the EQ-Exposed group had one or more symptoms. Locally, it was reported that hyperarousal was the most common symptom in children referred for mental health services during the earthquake period (Clay & Bobier, 2012).

Relationships with Stress Symptoms

Relationship to Gender

As behaviour problems and post-traumatic stress symptoms are related to gender, and gender is a risk factor for both behaviour problems and PTS, the relationship between these factors was examined. In both the Pre-EQ and the EQ-Exposed groups, at the start of school, boys had more behaviour problems, PTS and arousal symptoms than girls, as would be predicted.

In evaluating the changes within gender, only girls showed significant increases in BPI and PTS between the Pre-EQ and EQ-Exposed groups, while the increases for boys occurred, they were not significantly different (Table 4.7). However, both boys and girls showed significant increases in arousal symptoms. The significant changes for girls are in accord with the predicted impacts of disasters on girls, but the elevation in arousal symptoms for boys has not previously been reported.

One potential reason for the added impact on girls is that the regions of the brain that are affected by PTS, including the amygdala and hippocampus, differ between boys and girls (Ruigrok, Salimi-Khorshidi, Lai, Baron-Cohen, Lombardo, Tait & Suckling, 2014). This may make girls more vulnerable to the effects of trauma.

Additional reasons for differences between girls and boys are discussed by Olff (2017). One, derived from research on adults, is that during the acute phases of the trauma, men and women use different types of coping. Men might respond with a fight-flight reaction, but then use problem-focused coping, which is a positive coping strategy. Women, on the other hand, might be more likely to use emotion-focused coping strategies, such as avoidance coping, which are not considered to produce as positive effects compared to problem-focused coping. In the present study, the coping strategies used by the very young children at the time of the trauma were likely to be emotion-based. These coping strategies are discussed in the next chapter.

Table 4.7. Means (SD) on Behavioural Measures for Boys and Girls in the Pre-EQ and EQ-Exposed Groups.

Measure	**Gender**	**Pre-EQ**		**EQ-Exposed**		**Difference**
		N	Mean (SD)	N	Mean (SD)	*p*
BPI	Boy	146	4.99 (6.2)	162	5.45 (6.9)	p =.54, *ns*
	Girl	151	2.60 (4.2)	144	4.43 (6.7)	.0051
PTS	Boy	146	2.40 (2.4)	162	2.90 (2.9)	.102, ns
	Girl	151	1.54 (2.1)	144	2.53 (2.8)	.0007
Arousal	Boy	146	1.34 (1.3)	162	1.95 (2.2)	.0037
	Girl	151	.77 (1.1)	144	1.35 (1.8)	.0009

Relationship to Neighbourhood Deprivation

Behaviour problems and post-traumatic stress symptoms are also related to socioeconomic status. Living in high deprivation neighbourhoods is a risk factor for both behaviour problems and PTS. In the Pre-EQ group, children living in high deprivation neighbourhoods did appear to have higher mean scores (Figure 4.1). However, analysing scores did not show a significant difference across the means BPI (p=.332), PTS (p=.248) or arousal (p=.159) scores in the Pre-EQ group.

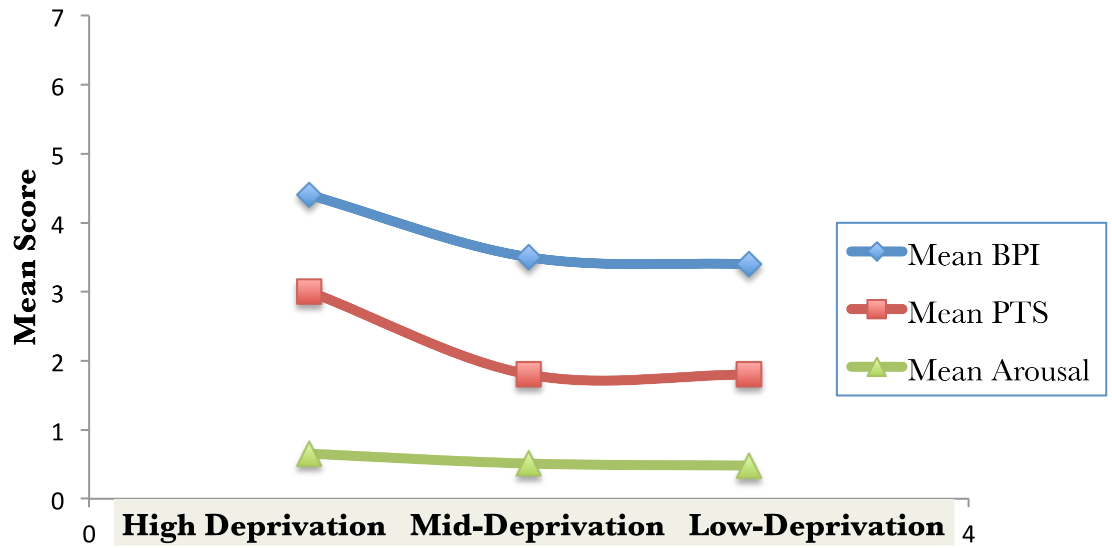

Figure 4.2. Behaviour Measures in the Pre-EQ Group, Relationship to Neighborhood Deprivation

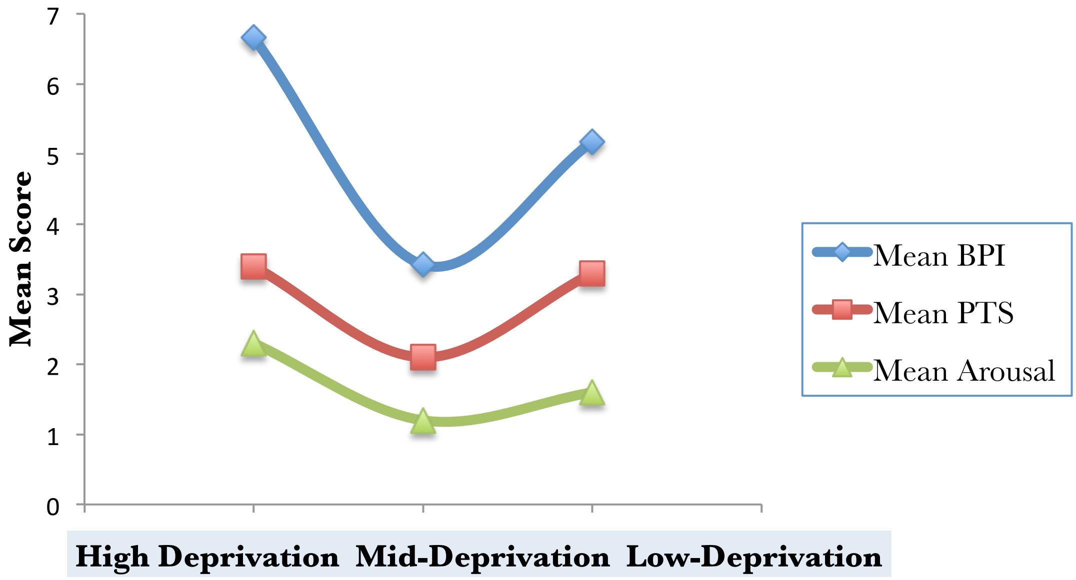

Figure 4.3. Behaviour Measures in EQ-Exposed Group, Relationship to Neighborhood Deprivation

In the EQ-Exposed group, however, there was a significant difference across the means for BPI (F=5.49, *p*=.005), PTS (F=6.164, *p*=.002) and arousal (F= 8.334, *p*>.001).

A visual analysis of the means shows a U-shaped distribution (Figure 4.2) for the EQ-Exposed group, but not for the Pre-EQ group. A U-shaped distribution associated with the disaster event can be explained relative to concepts of resilience (Bush, Obradović, Adler, & Boyce, 2011; Chen & Miller, 2012; Masten & Narayan, 2012; Seery, Holman & Silver, 2010). Children from neighbourhoods of high deprivation have been shown to experience more adverse events, and display more behaviour problems (Figure 4.2). When a disaster strikes, this adds to the cumulative burden of adversity and therefore this group would be predicted to display additional problem behaviours.

Children from neighbourhoods of low deprivation are often protected from adverse events due to family resources, which might include higher levels of family education and material supports. Thus, in normal contexts such as the Pre-EQ Christchurch, as a group, these children are less likely to have behaviour problems. However, once a disaster strikes, the relative lack of experience in coping with adverse events, such as EQ-Exposure, means these low-deprivation children have lower resilience, and also show relatively high levels of behaviour problems. It has also been theorised that families from low-deprivation areas may

also have experienced greater loss of resources, which increased levels of stress and reduced resilience (Bush, Obradović, Adler, & Boyce, 2011; Chen & Miller, 2012; Masten & Narayan, 2012; Seery, Holman & Silver, 2010)

Children from middle-deprivation neighbourhoods are neither overly protected from adverse events, nor do they experience frequent adversity. It is thought that exposure to some stressful events –but not too many—is necessary for the development of resilience. It is thought that families in the mid-deprivation ranges experience adversity, but also have sufficient family and material resources, as well as experiences, to cope with adversity, and thus show enhanced resilience — or, in the present study, lower levels of problem behaviours and PTS — as compared to children from either high or low deprivation neighbourhoods.

Relationship to Ethnicity or Cultural Identification

Ethnicity or cultural identification is also a risk factor for PTS and behaviour problems. In both the Pre-EQ and the EQ-Exposed groups, at the start of school, Māori had more behaviour problems, PTS and arousal symptoms than European children (not controlling for deprivation), as would be predicted (Table 4.8).

In evaluating the changes between the Pre-EQ and EQ-Exposed groups within ethnicities as shown in Table 4.8, only Europeans showed significant increases in BPI and PTS between the Pre-EQ and EQ-Exposed groups, while the small increases for Māori that occurred were not significantly different (Table 4.8). However, both European and Māori showed statistically significant increases in arousal symptoms.

Māori study children showed significantly lower impacts of the earthquakes as compared to the Pakeha children, according to study results. These results are not in concordance with the predicted effects of disaster in Western countries, in which children from minority groups are typically expected to show greater impacts than children from the majority group.

Table 4.8. Comparison of Mean Scores (SD) on Study Measures Across Pre-EQ and EQ-Exposed Groups

	Ethnicity	Pre-EQ		EQ-Exposed		Differ-ence
		N	Mean (SD)	N	Mean (SD)	*p*
BPI	European	222	3.45 (4.9)	229	4.76 (6.7)	.019
	Māori	47	5.13 (6.8)	53	5.85 (7.8)	.63 ns
PTS	European	222	1.87 (2.3)	229	2.66 (2.9)	.0015
	Māori	47	2.34 (2.2)	53	2.94 (2.7)	.23, ns
Arousal	European	222	.97 (1.2)	229	1.61 (1.98)	.0001
	Māori	47	1.32 (1.2)	53	2.04 (2.13)	.04

Dr. Sonja Macfarlane has suggested that the reason that Māori children showed a non-significant impact might be related to cultural factors. One important factor is social support, and other researchers have reported that social support from whanau is important in ameliorating the impacts of the earthquakes (Lambert & Mark-Shadbolt, 2012; Lambert, Mark-Shadbolt, Ataria & Black, 2012). In the EQ-affected group, 46.7% of Maori families reported that friends or relatives came to stay for one month or more, as compared to 16.1% of European families (Chi-square =15.098, p >.001). Thus, parent-reported data tends to confirm this as a possibility.

Another possible reason is that Māori families might be more likely to use co-sleeping, which could help calm children's nighttime fears and improve their sleep, thus reducing symptoms. Although parents were not asked about co-sleeping, Māori children in the EQ-Exposed group had more parent-reported sleep problems than European children, so this potential explanation does not seem as likely an explanation for the present study.

Another potential reason is that Māori parents might use an explanation for the earthquakes better suited to their cognitive development. For example, Māori parents might have explained to children that the earthquake was caused by the god Rumaumoku having a 'bad day' and shaking the earth. This type of explanation may be more understandable to children than an explanation that the earthquakes were random geological events. This explanation,

which was developmentally more understandable to children younger than four years of age as compared to an explanation based on the concept of chance, may have helped Māori children exert greater downward control from their prefrontal cortex to the amygdala, and thus not exhibit greater numbers of problems. Other studies have suggested that how traumatic events are explained to children is a key element in helping them be able to control their fear (Schultz, Langeballe & Raundalen, 2014). This option was not investigated in the present study, but it remains a possible explanation.

Another possible reason is that more Māori children (51.6%) as compared to Pakeha children (33.7%) were with their parents for each of the major earthquakes during the 2010-2012 exposure period but this difference did not quite meet statistical significance (p= .053). However, parental presence during the disaster has not been shown to be a determining factor in the development of children's PTS. Thus, although it is a possibility that separation from parents during a severe earthquake can help explain later PTS symptoms, the present study does not confirm this.

A final possibility is that Māori children and families may be more resilient following disasters due to the experience of families in coping with other adverse events, such as poverty, racism, health inequalities, and other forms of adverse events (e.g., Harris, et al., 2012; Marriott & Sim, 2015; Reid, Taylor-Moore, & Varona, 2014). This previous exposure may have assisted Māori parents by strengthening family coping, 'innoculating' them against some of the effects of the earthquakes (Palgi, Gelkopf, & Berger, 2015).

In some families, coping with adverse events can reduce the impact of subsequent trauma, but in other families, previous experiences can increase the risk of PTS (Sinclair, Wallston & Strachan, 2016). These relationships are not well understood but this is another potential explanation for the fact that Māori children in the EQ-Exposed group showed no significant changes in behaviour problems and PTS, while the European group showed significant increases in problems.

There are several important possibilities for the increased impact on children from European families.

Relationship to Age at the Start of the Exposure Period

Age at the start of the exposure period has been shown to be related to the severity of later PTS symptoms (Liberty et al, 2016); an analysis conducted on children entering the study in 2013 and 2014. A further analysis, included the children who entered the study in 2015

(Figure 4.3). The differences in BPI, PTS and Arousal between children grouped by developmental age in six-month intervals showed statistically significant changes [BPI: $F=3.872$, $p=.001$; PTS: $F=3.308$, $p=.004$; Arousal: $F=3.049$, $p=.007$].

Children whose exposure experience began when they were between the ages of 12-24 months showed the highest group means for each of the three scores. These data can be related to the theory that there might be significant sensitive periods for neurological development, and traumatic events have been identified as a major factor affecting neurological development (Anderson, Tomada, Vincow, Valente, Polcari & Teicher, 2008; Carrion, Weems & Bradley, 2010; Hanson et al., 2015; Pectel & Pizzagalli, 2011). However, the differences in the present study could be due to different distributions of children with other significant risk factors, such as gender, interacting with age, and associated with the relatively small numbers of children in each age category.

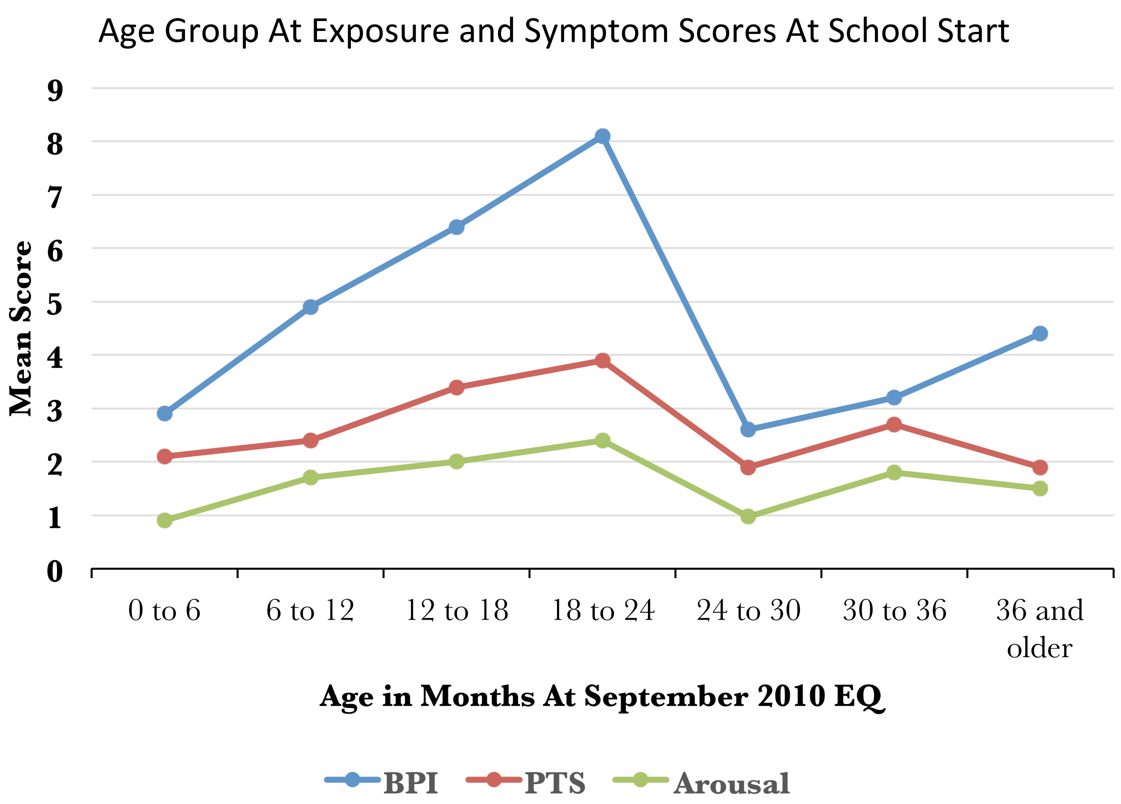

Figure 4.4. Mean Scores by Chronological Age Group at the M7.2 Earthquake at Start of the Exposure Period, 4 September 2010.

Comparison of Health Problems

A second concerning issue is that posttraumatic stress symptoms are associated with poor child health. In particular, issues that disrupt sleep are related to behaviour problems and associated with learning problems, particularly memory. Many teachers have noticed that children seem tired, but it's not well known that sleep problems are associated with posttraumatic stress. Headaches, stomachaches and eating problems are also symptomatic of child posttraumatic stress and related to difficulties in concentration and learning. Between 2014-2015, parents of the study children reported their children's health-related conditions that are associated with stress disorders (Gupta, 2013; Zhange et al., 2015).

Table 4.9. Comparison of Parent-reported Health Problems Across Pre-EQ and EQ-Exposed groups

Health Factor	Pre-EQ	EQ-Exposed	Probability
Trouble Going to Sleep	11.4%	28.4	p>.0001
Nightmares	18.8%	43.2%	p>.0001
Bedtime Fear	3% *	37.2% **	p>.0001
Waking in the Middle of the Night	17.8%	47.9%	p>.0001
Any Sleep Problem	36.9%	72.4%	p>.0001
Changes in eating or eating problems	9.7%	13.5%	p=.167, ns
Headaches	3.4%	18.6%	p>.0001
Stomach aches	9.7%	36.4%	p>.0001
Ear Infection	12.1%	21.1%	p=.004
Other	5.7%	24.7%	p>.0001

*Fear of going to bed * Fear of sleeping alone.

The mean number of sleep problems (of the four shown in Table 4.9) in the EQ-Exposed Group was 1.55 (SD=.1.41), significantly higher (p>.0001) than the Pre-EQ Group (Mean=0.51; SD=0.78). Overall, about 73% of the study children are having problems with their sleep. This is also a sign of arousal problems, as sleep problems are one of the symptoms associated with a diagnosis of PTSD in childhood (DSM-5, 2013). The fact that fewer children are having hyperarousal problems at school than children are having sleep problems

suggests that some children are able to control their behavioural symptoms at school, but perhaps not at night.

Parents also reported that significantly more children who were exposed to the earthquakes were having stomachaches, headaches, ear infections and other health problems. These are symptoms that the child's body is not able to cope with the stress that is being experienced. These symptoms are further evidence that the children's autonomic nervous system (ANS) is dysregulated – sleep cycles, digestion, circulation and immune function are regulated by the ANS. Headaches can be associated with dehydration and stress, ear infections with problems with the immune system, and stomach aches associated with indigestion and stress – all regulated by the autonomic nervous system. According to Rees (2014; see box), the importance of the autonomic nervous system to children's development cannot be discounted. It is critical to consider how the children's health may be undermining their learning and behaviour in school, rather than only consider behaviour problems at school.

The ANS anticipates the extent of need to adapt. It generates alertness and sensory sensitivity when danger warrants it, allowing concentration, intellectual learning and its application, reproduction or somnolence when it does not, optimising available resources through circadian rhythm, and cooperation through time perception. It adjusts fitness and modulates pain sensitivity according to circumstances. It modifies the extent to which vigilance to the environment overrides, or not, the value and possibility of sensitive attunement to others.

Study Limitations and Strengths

This study has significant limitations. First, the schools in the EQ group were not randomly selected, but volunteered to participate, while the Pre-EQ schools.

First, the study is limited by recruitment difficulties for the EQ-exposed group. Recruitment difficulties are commonly associated with research in a post-disaster community (Overstreet, Salloum, Burch, & West, 2011). The estimated recruitment rate is better than some other post-disaster studies (e.g., 39% in Moore & Varela's 2010 study of elementary school children; 25% in Sprung, 2008 study of preschool and elementary school children) but much less than the 86.4% reported by Jia and colleagues (2013) for older children and the 93% recruitment rate achieved in the Pre-EQ study (Liberty, et al 2010).

Second, significantly more children from high SES in the EQ-exposed group also limit the findings, and it is likely that actual rates are higher, as previously discussed.

Third, there is only a single informant for PTSS symptoms (some reported by teachers and some reported by parents), and the children are too young to self-report. Ideally, information from parents about the behavioural symptoms would have strengthened the study. However, a recent review identified that only 31% of studies were able to provide multiple informants in a post-disaster context (Pfefferbaum, Weems, Scott, Nitema, Noffsinger, Pfefferbaum, Varma & Chakraburtty, 2013).

The study is also limited by the use of a behaviour-screening checklist, rather than diagnostic interviews to measure post-traumatic stress symptoms, although this is also a common feature of post-disaster studies as previously explained. The need to compare symptoms using a measure that had been used in the Pre-EQ study reduced the choice of measures. Since the symptom scale was extracted from the BPI, and not all key symptoms were assessed, it is likely that the PTSS was under-estimated for each child and across the groups as a whole.

Five, no information on prior diagnosis of mental health or other problems in the EQ-exposed group, or on changes in functioning associated with the EQ period, was available. However, given their very young age at the start of the exposure period, it would be very unusual for New Zealand children to have a diagnosed mental health condition that preceded the EQ. In addition, changes in functioning related to the EQ may be difficult to determine as the EQ was not a single event, but an extended period of traumatic events of 17 months or more, followed by serious post-EQ stressors.

Finally, experimentally controlled evidence that the post-traumatic stress symptoms at age five years are associated with EQ rather than pre-existing stressors is missing; this is a limitation because pre-earthquake risk factors in the EQ-exposed group, such as parental mental health, was not studied. Future research using standard clinical interviews and

involving parents would be essential to determine the prevalence of PTSD in children associated with EQ.

There are also a number of strengths of the existing study. First, having a baseline study of mental health in a very similar group of children is very unusual, and an advantage in terms of showing the impact of the disaster on the community (Liberty et al., 2016). Second, studying children who were affected by a series of earthquakes at young ages has not previously been reported, and is another strength of the study, as is measuring both behavioural and somatic symptoms. An additional strength is that this is a longitudinal study, and that it has been conducted reasonably well, although on a small budget as compared to other longitudinal studies.

Discussion

The rate of PTS in the Pre-EQ group of 8.8%, is about the middle of the estimated range for non-disaster communities and reflects children who were exposed to traumatic events in their families who develop PTS, as reported in a meta-analysis conducted by Alisic, Zalta, van Wesel et al., 2014.

The approximately 20% prevalence of children with 6+ PTS symptoms in the EQ-Exposed group at school entry is lower than the 50% of children with a mean age of five-year who had more than 5 symptoms after Hurricane Katrina. That comparison may not be pertinent because that study included many children who had experienced at least one other traumatic event prior to the Hurricane, and were also attending a special clinic (Scheeringa & Zeenah, 2008).

In the Juniors EQ-Exposed group, 68% had between one and five symptoms (of 10) at the start of school. This is much greater than the 33% of older children who had symptoms 1.5 to 2 years after the Great Japan Earthquake in 2011 (Fujiwara, Yagi, Homma & Mashiko, 2017). However, that earthquake had significantly different features, such as the epicentre being in the ocean, being followed by a tsunami, and having less than half the number of aftershocks during a similar length of time as the exposure period defined for the present study (The Japan Times, 2013).

Individual Pathways at School Start

As all of the study children in the Earthquake-Exposed group met the requirement for experiencing a natural disaster, their BPI score as they started school was compared with the individual pathways identified by Masten and Narayan (see Chapter 1).

Children who started school with 0,1 or 2 problems were considered to be stress resistant at the start of school, Pathway A (Figure 4.5). (They could perhaps be on Pathway C, but traumatic growth was not identified because there was no measure of children's pre-earthquake status that could show that the child was functioning at a level above their pre-earthquake level. In addition, post-traumatic growth has not been studied in such young children). Children with 3-7 problems were identified as on Pathway B. Children with more than 8 problems were identified as being on pathways D or E, because there was no way to identify if the onset of problems was delayed, since children entered school with the problems. The Juniors Study indicated that almost half of the study children had one or more stress-related problems during their first years at school, including children on pathways B, E and D.

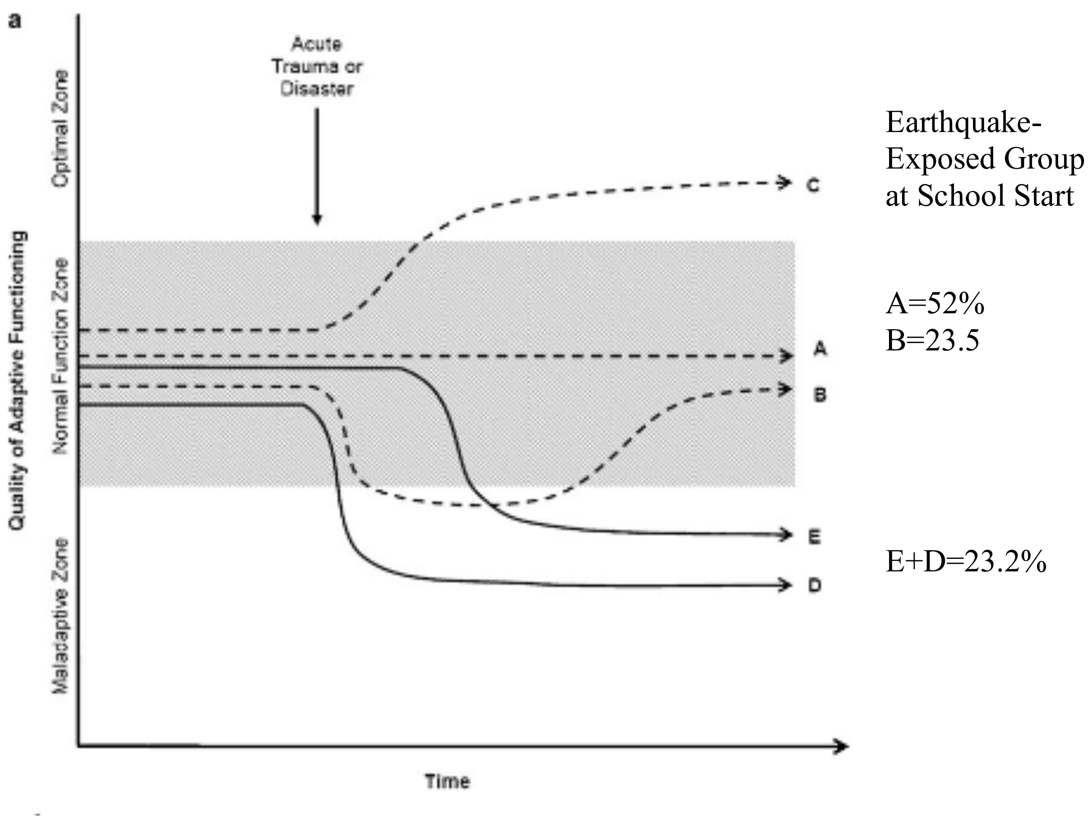

Figure 4.5. Estimated distribution of Juniors Study Earthquake-Exposed children on the individual post-disaster pathways identified by Masten and Narayan (2012).

Although it is more than five years since the earthquakes started, indicators of family well-being in Canterbury continue to reveal that many families with children are feeling persistent stressful impacts. Parents of the study children indicated that many children and their families experienced stressful events related to the earthquakes when they were younger than four years of age. About half of the study parents identified these experiences as constituting high stress in their family.

Data published by the New Zealand government in 2016 (Statistics New Zealand (2016) stated that only about 54% of parents in two-parent families felt mentally healthy, and only about 31% of sole parents felt mentally healthy (Figure 4.6). A report prepared for the Canterbury Earthquake Recovery Administration in 2015 stated that, “Just under three quarters (73%) of greater Christchurch residents have experienced stress at least sometimes in the past 12 months that has had a negative effect on them, . . . with 20% saying that they experience this stress most or all of the time (Nielsen, 2015, p. 38). In 2016, the figures were 72% and 20%, respectively (Nielsen, 2016, p. 41). This is just one of a set of indicators about the stress in families. One key cause of stress in families is worry and concern about their children’s learning and behaviour, and these indicators align with the findings of the Juniors Study.

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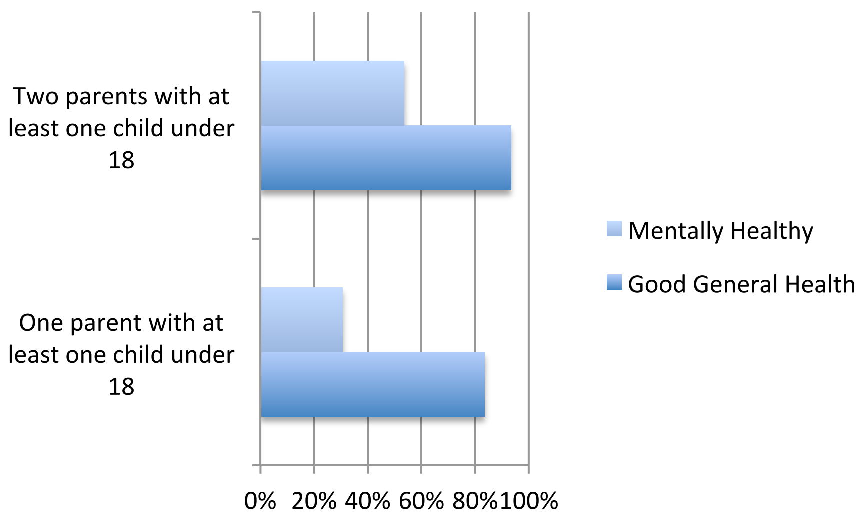


Figure 4.6. General and mental health in Canterbury families (Statistics New Zealand, 2016).

Parents also indicated that even today, years after the earthquakes, many children are showing signs that their body is stressed. This means more children are having sleeping problems,

headaches, tummy aches, eating problems, and so forth. When this is compared with the pre-earthquake study of children from similar parts of the city, it is clear that many more children are experiencing problems due to their exposure to the earthquakes and the post-earthquake events that have affected Christchurch.

The Baseline Adversity Rate in Christchurch

A recent estimate of the prevalence of adverse experiences in childhood has upped previous estimates to one in two children experiencing traumatic events (Perfect et al., 2016). And, a study of primary-school-aged children has identified that of the children who have experienced at least one event, about 75% developed moderate or high numbers of post-traumatic stress symptoms (PTSS) (Gonzalez et al., 2016).

However, in Christchurch, the present study indicated that almost every child had experienced one or more natural disasters, including the Canterbury earthquakes and floods. Natural disasters, in addition to being ‘adverse’, are traumatic. This makes this community’s situation quite different to many of the studies of adverse experiences, because, instead of starting with a baseline of, say, 50% of children with no adverse experiences, Christchurch in the realm of perhaps 10% with no experience of traumatic events. This has serious implications for schools in the present day, as well as for the future of this community. In the following chapters, the ramifications of this situation, and a beginning response to address the high prevalence of children whose cumulative experiences of adverse events is impacting on their potential, their families, their schools, and communities are described.

The information from the study has been disseminated to the parents, principals and teachers involved in the study, and then gradually to the wider community. The evolution of the study eventually led to the development of school-based strategies to address children’s post-traumatic stress symptoms, described in the following chapters.

Chapter 5
EQ-Exposed, Stress-Sensitive Children Settle into School

Stress and Challenges in Primary Schools

Starting school is itself associated with increased stress, such as meeting new children and learning the skills needed to get along with them, following teacher directions and learning the behaviours expected in school, and the challenges of learning to read to write, complete math tasks and explore science concepts, for example.

A stressor is in the eye of the beholder to some extent. In term of stressors in the school environment, being confronted by a bully, for example, is a stressor for every child. However, the presentation of a new math problem, for example, may or may not be perceived as a stressor. Whether or not a particular event is a stressor will be determined by the child's past experiences of that event (e.g., whether they have successfully coped with new math challenges in the past), but also by the number of stressors they are experiencing at the present time, which may or may not be known to the teacher or to the parent (e.g., discord at home; bullying during play time), and their past experinces that have shaped their physiological reactions to stress (e.g., extended poverty, extended earthquakes).

When the child can meet and accommodate to the demand inherent in the stressor, it represents a challenge – and challenge is necessary for learning. Challenge stimulates the production and trial of new and novel responses – learning. Learning does not arise from merely repeating previously learned responses. Learning arises from the challenge/stress associated with the opportunity to respond to a new event. However, when the child, for whatever reason, cannot meet or accommodate to the demand, stress can occur.

Stress in daily life is a normal part of every day experiences, and there is no way of avoiding it completely. For example, forgetting homework, losing a sunhat and struggling to learn to read all represent some common demand situations that children may encounter in everyday school life that are associated with potential stress. In fact, manageable amounts of demand can sometimes help a child to become stronger and more resilient. However, when there are too many demands or the child is sensitive to stress due to the presence of adverse events in

their life, or their accumulated experiences of past adverse events, the child may experience stress at that moment.

Thus, because of the multiplicity of events impinging on the child's HPA axis and autonomic nervous system, to the outside observer, there may be little or no apparent reason for the child's stress response. It seems that there would be 'no reason for a meltdown like that" because the accumulated events are not directly observable in-the-moment that the child's ability to cope fails.

What is a Stressor?

> *A stressor is any kind of condition, which presents an environmental demand that exceeds the natural regulatory capacity of the individual. A stressor can be of a physical or psychological nature, tangible or mentally evoked. The subjective state of sensing these possibly adverse conditions is termed 'stress' and it leads to the activation of two systems: the sympathetic nervous system and the hypothalamus-pituitary-adrenal axis.*
>
> *Shira Drexler & Oliver Wolf, 2017, Stress and Memory, p. 285*

Too much stress can interfere with children learning reading, writing and maths, as well as disrupt the achievement of developmental and behavioural milestones, such as those associated with self-regulation.

Research has documented that elevated cortisol, a biomarker of stress, increases at the start of school, even in healthy children (Bruce, Davis & Gunnar, 2002). Regarding the Autonomic Nervous System, the HPA usually responds to a stressor with a relatively short period of elevated cortisol release into the bloodstream followed by a gradual decline as either the stressor disappears or it is accommodated. Repeated experiences of the stressor should reduce the elevation levels. In healthy children, adaptation to the stress encountered during the first week of school may be evident in reduced cortisol elevation after five days (Bruce, Davis & Gunnar, 2002).

Children who have experienced high levels of adversity before school have significantly higher initial cortisol levels as compared to children with fewer adverse experiences (Cutuli,

Wiik, Herbers, Gunnar & Masten, 2010). However, in children with behaviour problems, the stress at the start of school, as measured by increases in cortisol, is associated with increased parent-reported behaviour problems and changes in immune system functioning for weeks after the start of school (Boyce, Adams, Tschann, Cohen, Wara, & Gunnar, 1995). Children whose mothers suffered prenatal stress during their gestation have higher rates than other children (Gutteling, de Weerth, & Buitelaar, 2005). Five-year-old children who entered preschool in the USA had elevated cortisol and increased psychological and behavioural difficulties one year later (Hatzinger et al., 2013).

These studies indicated that children who enter school with higher levels of cortisol, a marker of HPA axis and autonomic nervous system function, are more likely to continue to have elevated levels, and less likely to show the pattern of adaptation and reducing cortisol levels shown by healthy children. In addition, as children grow older, they will naturally experience other sources of stress. This may be, for example, due to changes in their families (e.g., the birth of a sibling, parental break-up), illness (e.g., acquisition of asthma, accidental injury), or the experience of other stressors (e.g., parent unemployment, the death of a pet). As a consequence of accumulated stressful events, some children might be irritable at school and feel nervous or tense and therefore have difficulty in controlling their temper and expressing themselves in a positive and pro-social way. Their stress reactions might also be getting in the way of their learning.

There are many potential stressors at school!. Free clip art from: http://images.clipartpanda.com/stressor-clipart-rav.jpg

Young children's autonomic nervous systems do not always distinguish between daily stressors and life-threatening events, and their HPA axis may already be more sensitive to stress due to their past experiences. Therefore, when a child becomes stressed at school over a broken pencil, losing their sunhat, or the challenge of learning a new word during reading, their body can react as if they were facing a life-or-death situation. These repeated stress activations can make the child vulnerable to the process of developing positive mental and emotional regulation.

There are many ways that children learn to cope with stress – some of these are positive and can help a child grow and develop, while some are negative and can bring about behaviours

that prevent a child from functioning in a way that supports their healthy development and learning.

EQ-Exposed Children's Coping Styles

The biological research into the neurological changes associated with chronic stress identified that children are likely to have difficulties communicating their stress using language. Thus, children communicate stress, and cope with stress, through their behaviour. It is the responsibility of adults to correctly interpret and understand their communicative behaviours.

Children who were exposed to the repeated earthquake events during a sensitive period of their neurological development and to post-disaster stressors are at risk for poor expressive language development due to impaired learning, as well as difficulty with receptive language. They are likely to have difficulty accurately interpreting and responding to certain facial expressions and tones of voice-- they are more likely to see things negatively with a biological reaction to threat and to react with fear or angry behaviours.

Children who have post-traumatic stress symptoms may also have intrusive thoughts. Intrusive thoughts are not controllable by conscious effort and can be in the form of images, ideas, thoughts, sounds, smells and other sensory or body reactions (Kalivas & Kalivas, 2016; Reynolds & Brewin, 1998). Nightmares may also be one form of intrusive thought. These unwanted thoughts can cause children to behave or react in ways that are not understandable to those around them because the triggers are internal and can't be seen by others. Many people have intrusive thoughts that cause them distress, but healthy adults can identify and ignore them (Bryant, O'Donnell, Creamer, McFarlane, & Silove, 2011).

All of these issues can mean it is difficult for children to connect with others or for others to relate to them. It makes parents worry, and feel upset about their child's behaviour. It is also difficult for parents and teachers to connect with these children until they understand that the children's behaviours are expressions of stress.

Coping is a subset of emotional regulation, in that coping applies to emotional regulation in a stressful situation (Compas et al., 2014). However, coping goes beyond regulating emotions. Coping includes controlling or managing usually negative or distressful voluntary and involuntary psychological and physiological reactions. Coping can be defined as: "conscious volitional efforts to regulate emotion, cognition, behavior, physiology, and the environment in response to stressful events or circumstances" (Compas, Connor-Smith, Saltzman, Thomsen & Wadsworth, 2001, p.89).

Children are likely to have more than one coping strategy, and the ages of 5 to 10 years are the time when new coping styles can emerge. However, there has been little research into how children between the ages of 5-9 years cope with stress or the pathways of post-disaster recovery (Compas et al., 2014).

Four common ways that children cope with stress are described in the following section. Because they are children, they have had only a short time on earth, and thus they have far fewer ways to cope with stress as compared with adults! The coping styles of young children are thus likely to be quite different from those of older children, adolescents, and adults, who may use avoidance, problem solving and cognitive reappraisal, for example.

Coping Style 1: Self-Regulation of Stress

1 in 5
Study children had very good self-regulation most of the time (2015)

The ability to control your reactions to stressful situations is important for emotional well-being and is a key aspect of coping.

It can take many years for children to develop self-regulation, and even self-regulating adults sometimes have difficulty controlling their reactions and "lose it." It is important to remember that the accumulation of stressors can affect the ability to cope with subsequent stressors. Thus, self-regulation at a moment of stress is not a permanent state, such as having brown eyes, but is a moment-to-moment neurobiological state that can be affected –or dysregulated– by environmental changes.

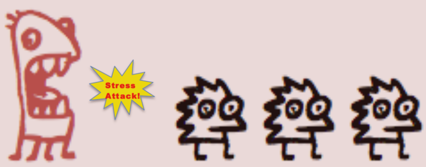
To develop volitional self-regulation in a stressful environment, children need to:

- Understand what is going on in their minds and bodies, so that they can recognise when their body is responding to stress,
- Understand and be able to infer the emotions of others from accurate perceptions of their face, tone of voice, body language, etc.,
- Have the words they need to tell others about their feelings and be able to ask for help when needed,

- Learn strategies to control their involuntary physiological reactions,
- Be able to direct their behaviour toward a particular goal, such as following directions, in a stressful situation.
- Be able to control their behaviour to recover from an upset to their physiological state caused by a stressor.

Once children have learnt some ways to self-regulate at a time of stress, they need to remember these strategies and put them in place at the right time on the occasion of another stressor. This can be difficult, particularly in the heat of the moment when children are confronting a trigger, experiencing an intrusive thought, hot, tired, and/or hungry in a stress-evoking situation.

Coping Style 2: Automatic Reactive Coping



1 in 3 or 4
Study Children Sometimes Use Reactive Coping (2015)

When stressors are experienced frequently, or the severity of stressful events increases, stress can overwhelm self-regulatory capacities and become ‘too much’ to handle or keep inside. If and when this point is reached, even seemingly minor events or daily hassles can cause a physiological reaction that is beyond the capacity of the individual to control it, resulting in emotional venting or “letting it all out”.

In adults, this can be seen during episodes of ‘road rage’, when a person may yell or swear if they encounter a common minor event, like just missing a green light. It’s not actually missing the light that is the real cause of their rage — missing the light is just the event that tips them over and they lose their ability to control their reactions. “Missing the green light” can also be thought of as the “last straw” – “the straw that breaks the camel’s back” in terms of volitional control over physiological reactions.

Irritability is one characteristic symptom of PTSD and also arousal (Bryant, et al., 2011). Compared with other localities, a many more adolescents in East Christchurch had high levels of anxiety or depression – which are mental health conditions associated with chronic and

post-traumatic stress—in a study that involved both surveys and in-depth interviews (Figure 4.2). In Christchurch, 44% of adolescents reported post-earthquakes that they had relationship problems within their families, and 35% reported arguing with their friends (The Prime Ministers Youth Mental Health Project: Localities and National Perspectives Evaluation, 2016).

Some stress-sensitive children may react in the same way as adults or adolescents when their stress level reaches the breaking point. Children who experienced the earthquakes may be very sensitive to stress. Even little things, which wouldn't usually be thought of as very stressful, can trigger a reaction in some children.

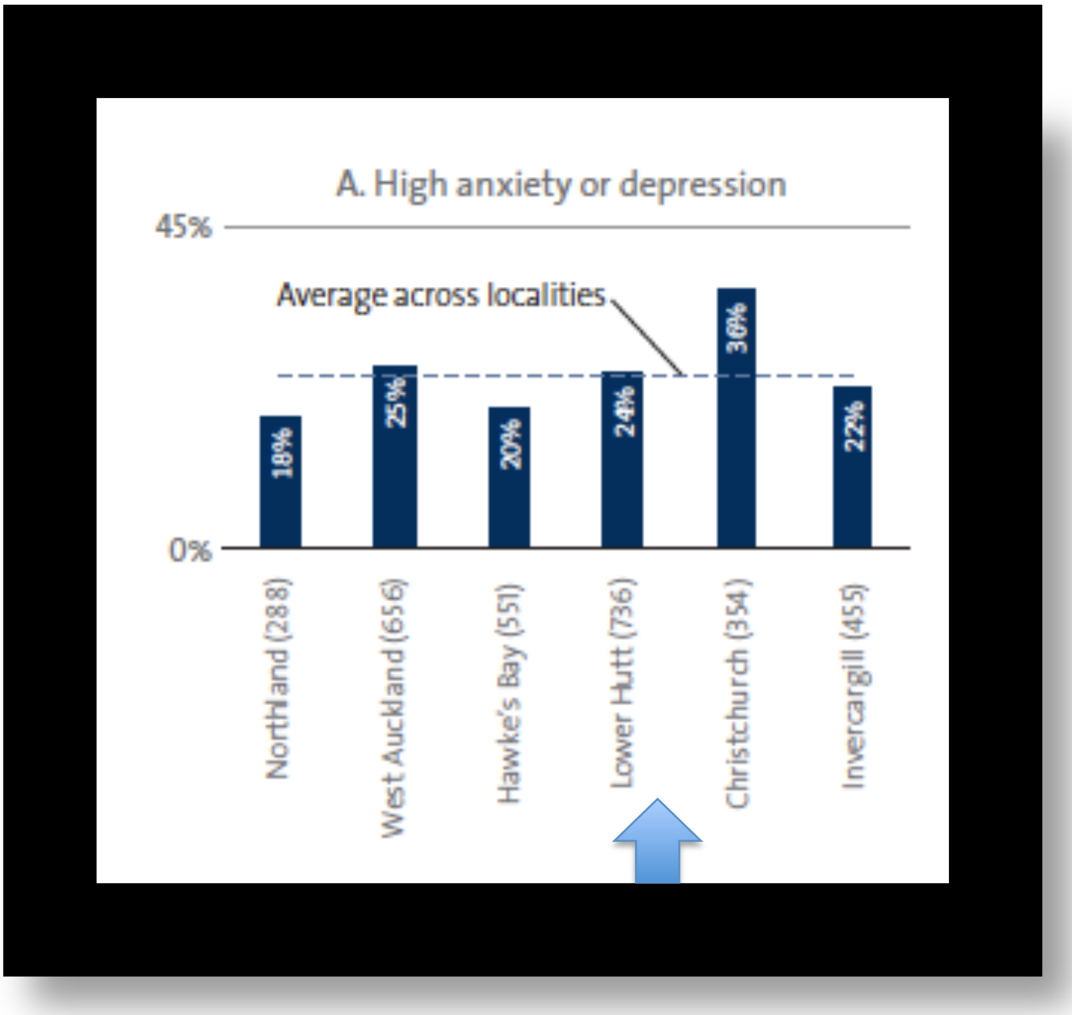


Figure 5.1.The proportion of youth reporting high anxiety or depressive symptoms. Source: The Prime Ministers Youth Mental Health Project: Localities and National Perspectives Evaluation (2016). Wellington: The Ministry of Health. (p. 32). http://www.superu.govt.nz/publication/ymh_localities_evaluation_2016

Stress-sensitive children can react to daily life stress and hassles by:

- Being irritable and moody,
- Lashing out at others,
- Screaming,
- Having a ‘meltdown’,
- Scribbling out their work, tearing it up, throwing it,
- Being aggressive,
- Arguing back or being defiant.

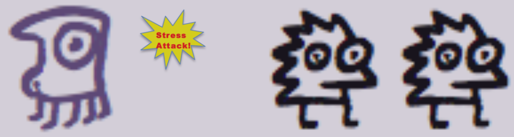
These types of reactive behaviours occur when stress has reached a high level and all other types of coping have failed. It is important to understand that the child does not consciously choose to behave in this way and their reactive coping strategy is an **automatic response. Remember, fear, fright, freeze, fight are all types of automatic responses.**

Research shows that some children’s nervous systems may be very sensitive to stress and this increases the likelihood that they will react to stress with aggression or other negative reactions. This reaction may reduce high heart rate and other physiological changes caused by the stressful event (Morris & Rao, 2013; Verona & Sullivan, 2008).

“Stress is defined as a state of threatened or perceived as threatened homeostasis. A broad spectrum of extrinsic or intrinsic, real or perceived stressful stimuli, called ‘stressors’, activates a highly conserved system, the ‘stress system’, which adjusts homeostasis through central and peripheral neuroendocrine responses. Inadequate, excessive or prolonged adaptive responses to stress may underlie the pathogenesis of several disease states prevalent in modern societies. The development and severity of these conditions primarily depend on the genetic vulnerability of the individual, the exposure to adverse environmental factors and the timing of the stressful event(s), given that prenatal life, infancy, childhood and adolescence are critical periods characterized by increased vulnerability to stressors.”

Pediatric Stress: From Neuroendocrinology to Contemporary Disorders. Stavrou, Nicolaides, Critselis, Darviri, Charmandari, & Chrousos, (2017)

Coping Style 3: Dependent Coping- Getting Help



1 in 3
Study Children used Dependent Coping at least sometimes (2015).

Another coping style to manage stress is by recruiting 'others to help.' In adults, getting help and support might involve meeting up with a mate, phoning a friend or family member, and getting their help and advice when things get really stressful. Accessing social support is one of the most researched of adult coping styles, and is associated with more positive adaptation to future stress.

Children, because of their age and developmental status, do not have access to these types of coping activities – they can't determine when it is time to call a friend, for instance, and they haven't necessarily learned how to identify the physiological states that identify stress accumulation. Instead, they must rely on help being provided by their parents and other caring adults wherever they are when their stress levels become overwhelming. So, in children, reaching out to adults when overwhelmed by stress is the development equivalent of reaching out to friends by adults.

As these children are not able to calm and cope by themselves, they are dependent on others to help them calm down. Hence the label, "Dependent Coping."

However, when children are overwhelmed by stress at a particular moment or have chronic stress disorder or post-traumatic stress disorder, they are not likely to be able to use their verbal language to ask for help. Instead, they are more likely to revert to the type of behaviour that succesfully recruited adult help when they were younger—clinging and crying. Also, remember that the part of their brain that controls reactions suvh as crying is the part of the brain that is most likely to be dysregulated, and this increases the likelihood that they will have to use more immature behaviour to appeal for help.

This type of coping may result in children:

- Crying,
- Whining / complaining,
- Clinging,
- Acting younger than their age,
- Anxious behaviours.

When primary age children are maxed out on stress they may use a dependent coping strategy as a way of asking for help from adults. It would be much more helpful if, instead of Dependent Coping, these behaviours were associated with reaching out for social support.

As children are sometimes not able to calm themselves down, crying, clinging or complaining / whining can be their way of getting an adult to help soothe and comfort them when things become too much. Providing support during this time is important, as children often do not understand their feelings and may think there's something wrong inside of them.

They are not doing this to get attention or to get out of doing something. They are not 'doing this on purpose' in order to create problems. Their bodies are reacting to accumulation of stressful events, feelings, memories, fear, noises, lights and other things and they are asking for help in the only way that they are able to at the moment.

Coping Style 4: Becoming Quiet Like a Turtle

This is a coping style that involves reacting to stress by "withdrawing into oneself" for a short period of time.

1 in 5
Study Children Use Withdrawal Coping at least some of the time (2015)

This kind of coping style is common in adults, although it goes by many other names. For instance, adults may "call in sick" to work or otherwise take a 'stress day." They may grab some chocolate and the television remote and hide out in the lounge by themselves. They may hop into the car and have a long drive into the country. Or, take themselves off to the pub for a quiet beer.

Of course, children are not able to do these kinds of activities. However, this type of coping strategy may be quite good because it may signal that the child has recognised that they can't cope with what is going on, and have withdrawn for a short period of time in order to reduce stress and feel calmer. This form of coping seems a very close step to recognising

physiological states associated with stress that is necessary to developing self-regulation, and may be a positive strategy.

Children who withdraw may result in children:

- Spending short periods of time alone,
- Watching from the sidelines instead of joining in when first introduced to a new activity,
- Not being curious or positively anticipating new experiences (as new experiences might be associated with stress).

When primary age children cannot handle even a little bit more stress, they may use a “turtle” coping strategy as a way of moderating their reactions. As children do not always have the right words to describe how they are feeling, becoming quiet can be one way of dealing with their inner emotions. However, this form of coping should only be used for relatively short periods of time. Long periods of withdrawal may be a symptom of more serious mental health issues, such as depression.

Take a brief ‘time out’ from a stressful environment may be a more mature style of coping with stress than automatic reactive or dependent coping. It may be a step toward self-regulation, when children learn to think before they act, but this has not yet been studied in young children.

In a busy, bustling classroom, where children are learning lots of new things, it may be difficult for some children to cope with all the new information, especially if they have some stress sensitivity from their early childhood experiences. Withdrawing ‘like’ a turtle may give such children some ‘quiet’ time to recover.

Multiple Coping Styles

Adults don’t use the same coping style for every stressful event. Adults use a range of coping styles. They don’t draw up a list and pick one – they do what strikes them first at the moment of the stress attack. The same is true of children; it’s just that they have a much more limited number of coping behaviours to react with. Therefore, it is up to adults to model coping and to help children learn how to cope with stress.

Adults might react to children to reduce their own stress. Adults may want the child to stop doing whatever it is that they are doing (to cope inside themselves) so that the adult can feel better. Unfortunately, some of the ways adults might use to get children to stop acting the way

they are, such as reprimanding, threatening, ignoring, or using a 'naughty step', are highly likely to cause more problems and less coping over the long term, as such actions re-activate fear responses. Appendix 1 describes evidence-informed strategies to help children develop emotion regulation.

Why are some children better at coping?

People ask why some children can better control their emotions, have stronger coping skills or have developed more consistent self-regulation compared to other children their same age. Also, why some children were affected by the earthquakes and associated trauma, while others did not. Research can offer some explanations for this: in particular, the Adverse Childhood Events study, which was a very large-scale longitudinal study in the USA (see Chapter 1). This study indicated that the experience of adverse events during childhood could have long-term consequences for physical and mental health in childhood, adolescence and adulthood. Although experiences and individuals differed quite a bit among the thousands of study participants, it was the accumulation of three or more events that predicted later mental health problems. Similarly, studies of children who develop stress-related problems have identified particular vulnerabilities that may impact on whether or not an individual child does develop problems later on. Below is a partial list of these issues.

1. *Differences in experiencing the earthquakes*. Experiences of traumatic events are a criterion for the development of PTSD. Even during the earthquakes, some children had different experiences that would have affected the probability of the development of PTS. Some lived in homes that did not sustain as much shaking or damage due to their positioning relative to the faults or due to their construction. Some children might have missed some of the earthquakes, as their families might have left town for a while. The map (Figure 5.1) from the Canterbury District Health Board (2017), illustrates some of the differences across the city in earthquake-related stressors. Any one of these differences in how the earthquake was experienced by the children could have affected children's present health and behaviour status.

2. *Recovery before school*. Some children might have been affected in the immediate aftermath, but then recovered by the time they started school. Older children and adolescents would have had their early developmental years to learn coping and emotional-regulation skills, and thus might have been less affected (Boden et al., 2016).

3. *Pre-earthquake development*. Some children might be more vulnerable because of their developmental status, for instance, they might have been born preterm or with birthing difficulties (Shaw, Espinel & Schultz, 2012).

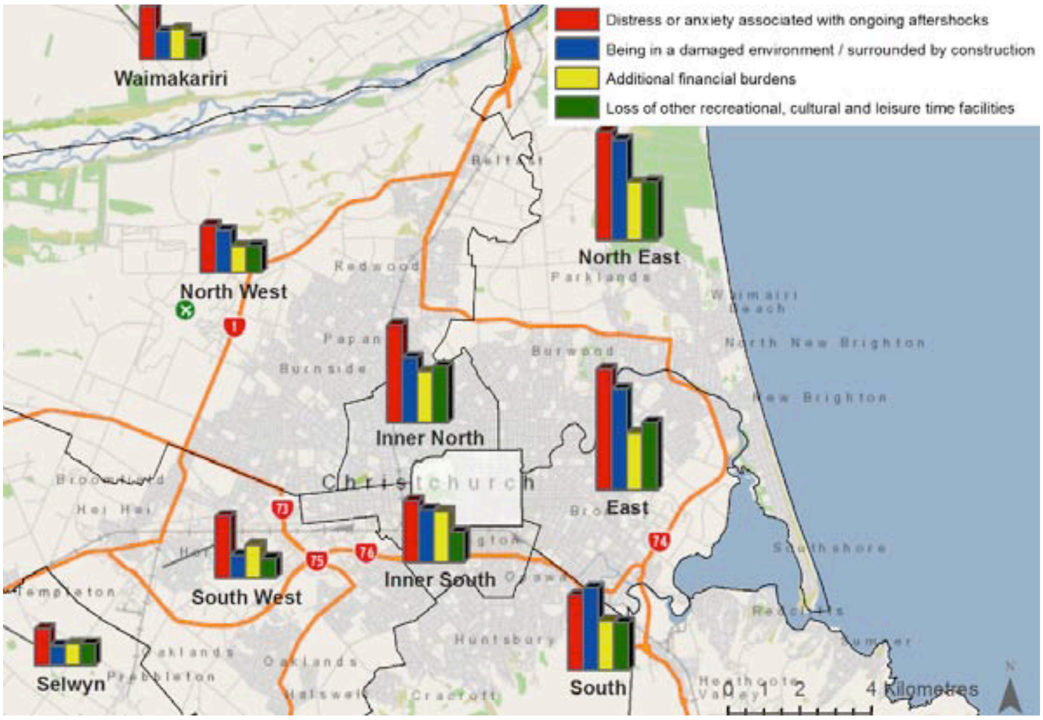


Figure 5.1. Regenerate Christchurch's Community Needs Profile for East Christchurch (2017) Otakaro Avon River Corridor Regeneration Plan (p. 19). www.regeneratechristchurch.nz

4. *Co-morbid conditions*. Some children might be more vulnerable because they have other conditions that create additional stress and are also associated with PTSD, such as asthma or diabetes (Goodwin, Fischer, & Goldberg, 2007; Huffhines, Noser, & Patton, 2016).

5. *Family vulnerability*. Some families might be more vulnerable, because of living in poverty, or pre-existing mental health problems. Some children might have had pre-earthquake traumatic experiences, such as witnessing domestic violence. These are also known stressors contributing to chronic stress disorders in children (Shaw, Espinel & Schultz, 2012; Stavrou, Nicolaides, Critselis, Darviri, Charmandari & Chrousos, 2017).

6. *Multiple traumatic experiences*. Some children might be more vulnerable because of a "cascade of stress" associated with post-earthquake events (Shaw et al., 1995). Events such as having to move house, change preschools or schools (leaving friends behind), loss of pets, changes to parent employment, additional people or relatives coming to live in the house, and health problems associated with injuries sustained during the earthquakes (2.4% of study

children were injured themselves during the earthquakes) are all associated with the additional potential for the development of PTS.

7. *School start*. Some children might have been able to return to their preschool or begin school earlier than other children due to family circumstances or the state of repairs at their school or preschool; re-opening schools quickly after a disaster is one of the recommended preventative steps a community can take in the wake of a disaster (Kingman, 1993).

8. *Family resources*. Some children's families may have more financial resources that can reduce some of the impacts of the disaster (Stepleman, Wright & Bottonair, 2009).

Thus, there are many potential reasons as to why some children cope better than others. Also, over time, children who coped well early on may later develop stress-related problems, due to the accumulation of adverse events. Repeatedly encountering adverse events can eventually lead to the break-down of coping strategies.

Are children making bad choices about behaviour?

There is a persistent myth circulating that young children who display concerning behaviour at school, such as interpersonal aggression, "make a decision" to act this way.

Have you ever burst into tears, or got angry in an instant? Or bitten someone's head off (and later regretted it)? Have you ever burst out with "X*&#"? Would you say of yourself that you 'made a bad choice'? Or would you say that sometimes, you 'just can't help it'? And, consider how many years and years you've had to learn coping strategies. But, even after all this time, and all the skills you've learnt to manage your own stress, there are times when you feel you just can't cope. These behaviour of crying, anger, swearing-- these are symptoms of stress, and what can happen when the stress in our 'coping bucket' tips over the top. We really don't tell ourselves that we "made a bad choice'—do we?

And children, who are so much younger, whose ways of thinking about the world are so different to adults (remember Piaget?), who have so much less experience, who have so much less freedom to choose what to do (after all, they do have to go to school, when many of us,

sadly, would never want to go back there again), -- should we really judge them more harshly than we judge ourselves?

It is important to remember that they are not behaving this way on purpose These children are sensitive to stress and have found it more difficult to develop positive coping strategies.

Longitudinal Behaviour Problems

The Juniors Study has shown that while some children are more resistant to immediate stressors in their daily life, others are sensitive to changes in their surroundings and find it difficult to cope with stress. According to research on the biology of stress, this sensitivity to stress in daily events is likely due to their exposure to many unsettling earthquakes before they were four years of age, and these result in the elevated numbers of children with behaviour problems, post-traumatic stress symptoms and arousal as discussed in Chapter 4.

The study revealed an increase in the number of children who have difficulty feeling settled in their classroom as they started school, compared to the pre-earthquake study. The next step was to determine what changed over those first few years of school.

Changes in Behaviour Problem Scores 2013-2015

As behaviour problems are reflective of children's emotional state, stressed children have more behaviour problems, and, if they experience more stress, these are expected to increase over time. Against this, healthy children who are schooled in a stable routine under the care and guidance of skilled teachers will normally show a reduction in behaviour problems, or, if they began school with few problems, they will be able to maintain this low level as they develop self-regulation skills needed to cope with stressful events (Blair & Diamond, 2008).

Of the 308 children who have been enrolled in the Juniors Study from the five schools, end-of-year reports for 2015 were available for 280 (91% retention), while the other children had moved. This included children who had entered school in 2015 and the children from the 2013 and 2014 cohorts.

Table 5.1. Percent of Study Children by Behaviour Problem Score Category at the Start of School and at the End of 2015.

Behaviour Problem Score	Children Exposed to Earthquakes	
	Age 5 School Start	At the end of 2015
0	31.0%	36.1%
1-2	22.0%	16.8%
3-7	23.5%	19.3%
8-14	12.7%	13.3%
15+	10.5%	14.6%
Number of children	308	280
Mean Score (S.D.)	4.97 (6.8)	6.0 (8.4)

The BPI data did not show a reduction in behaviour problems. At the end of 2015, 27.9% of study children had a score of eight or more behaviour problems (Table 5.1), which is a 28.8% increase. On average, teachers were grappling with six behaviour problems PER PUPIL in their classrooms, and the average child had one more behaviour problem than they did when they started school!

Another consideration is the proportion of children who do not display behaviour problems, in particular, because they can serve as role models for the other children in the class. This had increased by 17% by the end of 2015, with around 36% of the children not having any behaviour issues. While this was a positive change, it also seemed to be slightly at odds with the fact that for other children, behaviour problems were increasing.

The next step was to determine if children had basically maintained their behaviour problems since school entry, or if some had decreased numbers of problems, while others might have increased problems. To answer this question, the behaviour problem score of each child at the end of 2015 was compared with the child's score when they entered school at age five. (The children who started school during terms three and four of 2015 were not included in this analysis).

Using a model from a study of children’s rate of Posttraumatic Stress Disorder following disaster exposure by Osofsky, Osofsky, Weems, King, and Hansel (2015), children's behaviour problems scores were classified as low and stable at both time points (2 or fewer at each time point), decreasing (across one or more of the categories shown in Table 5.1), increasing (across one or more of the categories) or moderate/high and stable (8 or more

behaviour problems at both time points). Remember, the ratings for each child were completed by different teachers at the two time points, so this analysis is based on teachers independently completing the ratings for 2015, as the teachers had no knowledge of the children's ratings at school entry. This analysis of how children's behaviour problems changed from when they started school to the end of 2015 is shown in Table 5.2.

About 37.3% of the children were able to maintain their behaviour at a low level. These children entered school with few behaviour problems and have been able to maintain their behavioural status as they encountered school stressors and other life events. As entering school itself has been shown to be a significant stressor for many children, as previously discussed, these children have exhibited strong self-regulation in being able to maintain their behavioural control despite encountering new stressors.

Table 5.2. Percent of EQ-Exposed Study Children with Increasing, Decreasing or Stable Changes in Behaviour Problems at the end of 2015, and range across schools.

BPI Score Change Category	Frequency	School Range
Low and Stable	37.3%	23-51%
Decreaser	20.6%	15-32%
Increaser	26.0%	18-33%
High and Stable	16.2%	9.4-27%

Table 5.2 also shows that 20.6 % of the children have improved their self-regulation since they started school, with decreasing scores of problem behaviours. This decrease in problem behaviours indicates learned or developed self-regulation that is normally an outcome of the establishment of school routines, the effect of the high quality of teachers, and the adaptation of children to the expectations and requirements of school and other events in their lives.

Together, these two groups Low and Stable + Decreasers–comprise 57.9% of the children.

It is concerning, however, that 16.2% of children had high behaviour scores, and these children had not improved. Finally, 26% of children have had increases in behaviour problem scores since entering school.

The mean BPI scores of these groups of children are shown in Figure 5.2. The blue line shows children who were low and stable, maintaining their low score across the two time points with a mean just above zero. The decreasing children started with a score near 12, and ended with an average score of around two, as shown in the red line. Those children have shown a great deal of improvement. The purple line shows children entering school with an average score of

around 3, but, by the end of 2015, this group of increasers had a mean score around 14. There is also a final group (green line) who are maintaining a high and stable score of more than 14 on the Behaviour Problem Index.

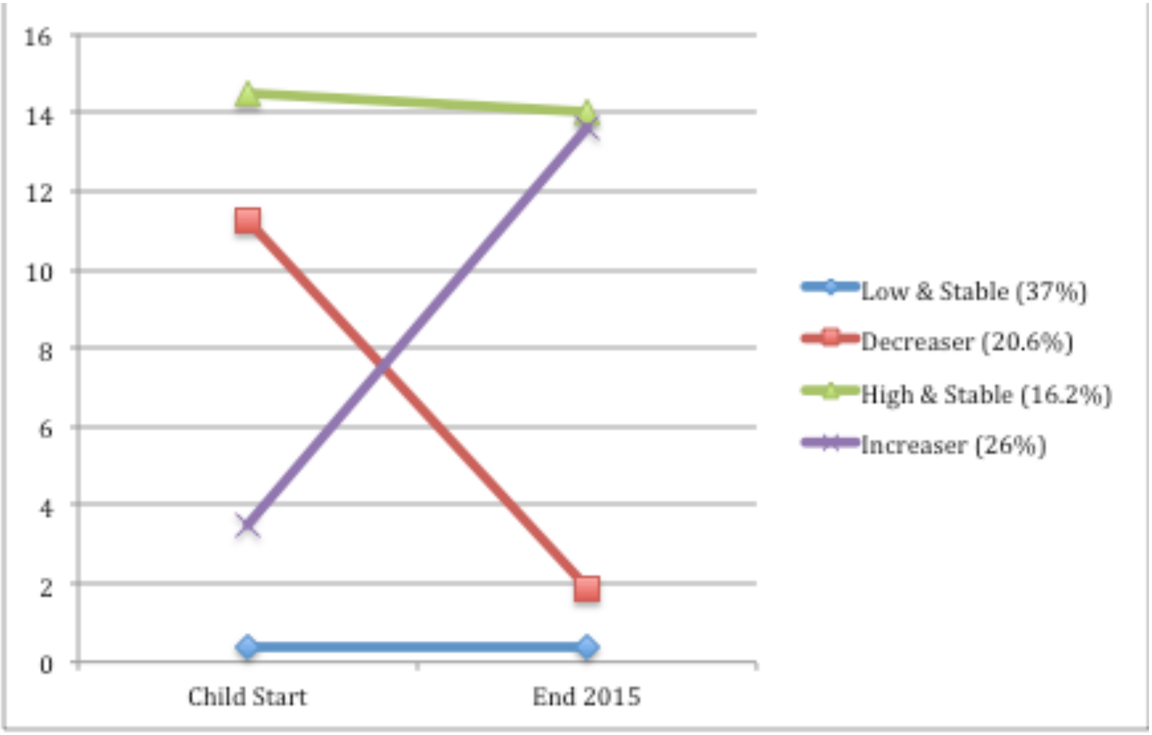


Figure 5.2. Mean BPI Scores of Children at School Start and the End of 2015 by BPI Score Change Category.

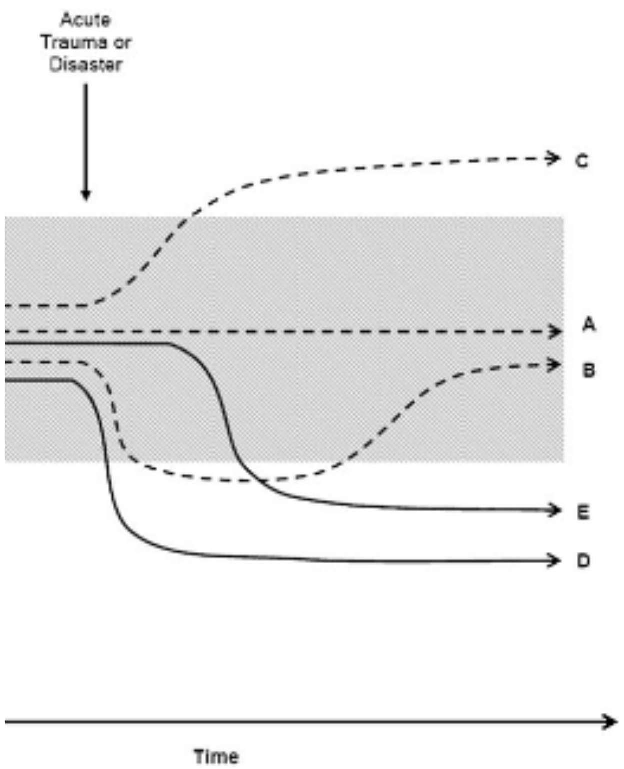
Overall, data show that 42% of the children have increasing or stable high behaviour problems scores by teacher report, with this group having a mean behaviour problem score of 14 (15 is the BPI cut-off indicator score for referral for mental health evaluation).

These extremely high BPI scores in so many children, after most had experienced two or more years of school, was very concerning.

When these data were shared with the principals of the schools, they agreed that this was representative of what was happening in their schools. They pointed out that many children attending their schools still walked or drove to school past damaged homes, shops and neighbourhoods, or had experienced flooding and school closures in their neighbourhoods, and they knew of other adverse events that had affected individual families.

Individual Pathways Revisited 2015

At this point, it was important to be able to interpret these changes. Without previous local experience as a guide, information from the research literature was used for comparison. First, a comparison was made with the individual pathways identified by Masten and Narayan (2012) (see Figures 1.3 and 4.5). Children who entered school with 0, 1or 2 problems and continued with that low level as on Pathway A (Figure 5.3). (They could perhaps be on Pathway C, but this was not identified in the present data). Children with decreasing problems were identified as on the recovering pathway, B. Children with increasing problems were identified as on the delayed post-traumatic stress pathway, D, and children with high numbers of problems at both time points were identified as on pathway E.



Strategy Schools

Start School	2015
A= 51% B= 24%	A= 37% B= 20.6%
E+D= 25%	E= 26% D=16.2%

Figure 5.3. Estimated distribution at the end of 2015 of Earthquake-Exposed children on the post-disaster pathways identified by Masten and Narayan (2012).

Continuing reports by teachers and principals of high numbers of concerning behaviours in children prompted the initiation of the Strategies Project to help schools establish calm environments.

First, all five study schools were invited to participate in trialling an experimental set of strategies in 2016. One high decile school declined, as that school had determined that they

would make no changes in 2016, as the school had reached its limit in terms of stress, and starting new strategies would cause more stress. Therefore, in order to understand more about the children's behaviour in the four schools entering into the Strategies Project.

PTS Symptom Change Over Time

The degree and severity of PTS symptoms have been shown to decline over time for some individuals, with and without treatment. In studies of disasters that are relatively short-lived, symptoms in older children seem to decrease within 18-36 months, although this may not occur when there are long-term disruptions to families and/or communities (Kronenberg, Hansel, Brennan, Osofsky, Osofsky & Lawrason, 2010).

Table 5.3. Post-traumatic Stress Symptoms in Pre-earthquakes Children Attending the Strategy Project Schools and in the Earthquake-Exposed Juniors Study Children

Post Traumatic Stress Symptom Score	**Juniors Study Children Exposed to Earthquakes & Other Stressors**	
	Age 5 School Start	At the end of 2015
No PTS Symptoms	30%	36.1%
Any PTS Symptoms	70.0%	63.9%
High PTS symptoms	*20.9%*	*18.0%*
Mean Score (S.D.)	2.9 (2.9)	2.7 (2.9)

In following up the concern about changes in behaviour problems, the changes in PTS symptoms were evaluated. By the end of 2015, across the four Strategy Schools, 63.9% of the study children had one or more of symptoms of Posttraumatic Stress (ranging from 44% to 82% across the schools), and 18% had six or more symptoms out of a total possible of 10 (ranging from 12-26% across schools).

Comparisons were based on longitudinal changes post-disaster. Osofsky and colleagues (2015) reported a very large longitudinal study of children exposed to both repeated

hurricanes and a large oil spill in the USA, and studied how their PTS symptoms changed over time. Similarly, Self-Brown and colleagues (2013) studied a different group of children followed from three months post-Hurricane Katrina. Study children's scores were similarly grouped according to the changes in their PTS scores since the children entered school (Table 5.4), using the categories reported by Bonanno, Brewin, Kaniasty and La Greca (2010).

Table 5.4. Comparative Analysis of the Change in Children's Posttraumatic Stress Symptoms Over Time by Category of Change

Comparison Factor	**Juniors Study, Strategy Schools**	**Self-Brown et al. (2013)**	**Osofsky et al. (2015)**
Number of Children	233	426	4,619
Age of Children	5-8 years	8-16	3-18 years
% Low Income	37.8%	N/A	72%
Type of Disaster	Canterbury Earthquakes	Hurricane Katrina	Hurricanes and Oil Spill
Change Time Period	1-3 Years (2013-2015)	3-25 months	1-4 Years (2009-2012)
Change in PTS Symptom Scores			
Low and stable (resistant)	22.98%	71%	52.1%
Decreaser (recovery)	23.8%	25%	21.1%
Increaser (delayed/accumulated)	**23.8%**	0%	18.1%
High and stable (chronic)	**28.1%**	4%	9.1%

Considering both the Osofsky and Self-Brown studies (Table 5.4), the EQ-exposed Canterbury children were much more likely to fall into the categories with high and stable scores ("chronic stress") and increasing scores ("delayed /accumulated stress") categories as compared to the other studies. The important differences between the study children and the children in the other studies are quite alarming, in that the Christchurch study children show that half (51.9%) of the children are holding steady at high rates or increasing to a similarly high rate, twice as many as the 27.2% in the Osofsky et al study and much higher than the Self-Brown study.

There are many possible reasons for the differences with these two studies. First, age differences, as the older children in other studies may have been less affected by the hurricanes and oil spill than the younger children in the Juniors Study who experienced the

earthquakes. Another difference might be that the earthquakes were quite different to the other two disasters, as, for example, no advance warning, and many aftershocks.

A third reason might be that researchers in both studies combined results across the different age groups, and that the older children were less affected. There are also significant methodological differences between the studies. Despite the possible explanations for the differences, the magnitude of the differences gave further evidence supporting the concerns of principals and teachers.

Bonanno et al. (2010) reported that while, at most, 30% of a population may develop PTSD, more than 50% are likely to be resistant to the effects of traumatic events or have mild and short-term effects, and most recover within 1-2 years post-disaster. However, while the results showed that about half of the study children were resistant or were on trajectories of recovery, half were showing chronic and delayed stress trajectories.

Within this group of PTS symptoms at the end of 2015, 52.4% of the Strategy School study children had one or more arousal-reactivity symptoms at the end of 2015 (range across schools: 40%-76%). This did not include children with sleep problems as reported by their parents – only teacher reports of behaviour in school context were used. Therefore, it is reasonable to conclude that many children's behaviour and health problems at the end of 2015 are the results of the earthquakes, post-disaster stressors, which have produced high numbers of children with PTS symptoms affecting their behaviour and their health and that these have been compounded by the additional family and individual stressors that normally occur during childhood.

EQ-Exposed Children's Learning: Reading, Writing and Maths

As behaviour problems are linked to learning, the next step was to evaluate learning. Information from the children's performance against the New Zealand national standards in reading, writing and math was collected from the participating schools in the Juniors Study. This analysis focused attention on children who are not meeting these standards (Figure 5.4).

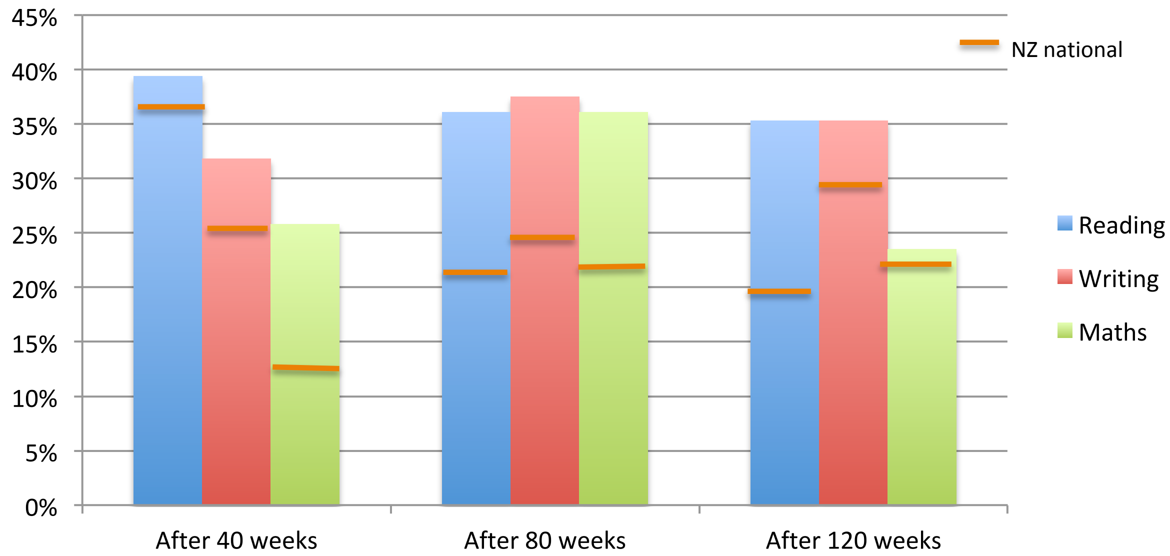


Figure 5.4. Percentage of Junior Study Children Failing to Meet National Standards. Group 1: Children who had completed 40 weeks of schooling by the end of 2015. Group 2, Children who had completed 80 weeks of schooling by the end of 2015. Group 3: Children who had completed 120 weeks of schooling by the end of 2015.

The bar graph shows the percent of the study school children not meeting the national standard for their level during 2015. Each bar cluster represents a unique group of children. Each study child still attending a study school appears once. Rates of failing to meet national standards in reading, writing and math are shown for children completing 40 weeks of school (i.e., one school year equivalent), 80 weeks (i.e., two years of school) and 120 weeks (i.e., three years of school). Children who entered school during 2015 are not included, as they had not completed 40 weeks of school. National standards had not been introduced at the time of the Pre-EQ study, so no Pre-EQ comparisons can be made. However, comparable national data for the first three years of school for all of New Zealand for the 2014 assessment round were available (Education Counts, 2017). The 2014 national results were the most recent data available at the time of analysis in December of 2015. The national rate of children failing to meet the national standard in each of the three main assessment areas is shown as a horizontal orange line for each bar in the graph. Any portion of the bar above the orange line is an area of concern.

These data indicate that many more children in the study schools were failing to meet the national standards as compared to New Zealand as a whole. Reading is a very important skill, and while the percent of children with reading evaluations below standard tends to decrease during the first three years of school across New Zealand, there is only a very slight decrease in the different years of school in the study children. This may mean that children who entered school three years ago in 2013 are slightly less affected than children who entered school in 2014, or it might mean differences in the impact of the specialist support given to children who are struggling with reading, math and writing in New Zealand schools. For children at the conclusion of year three, this is about double the number of children below standard in reading.

In considering children who failed to meet the national standards in writing, this is much higher in study children as compared to the national level. Calculating the percentage difference indicates about a 30% increase in children below standard in writing. In math, the percentage of children not meeting math standard is variable across the years, as can be seen in the differences between the children in year one and the children in year three in Figure 5.4.

A statistical analysis of relationships between the mental health symptoms and being below standard in reading, writing and/or math in the four Strategy Schools showed that the higher the behaviour problem score, the more likely the child was to fail the national standards after controlling for school and child's year level ($r=-.277$, $p=.001$).

According to the AACAP (2010), hyperarousal symptoms are often associated with impaired academic functioning. A correlational analysis of the number of arousal symptoms with children's performance on the national standard identified that children with hyperarousal symptoms were significantly more likely to be below standard in reading ($r= -.210$, $p=.009$), writing ($r=-.273$, $p=.001$) and math ($r= -.177$, $p=.028$) as compared to children who did not have arousal symptoms. Now this is hardly surprising, as one of the symptoms of arousal is difficulty concentrating. It is easy to understand the relationship between that difficulty and learning. 72 children passed the national standards in all three areas, and these children had, on average, no arousal symptoms. 29 children failed to meet the national standards in any skill area, and this group had an average of 2.13 arousal items per child (two items related to arousal are required to meet the DSM-5 criteria).

Evidence-Informed Interventions for PTSD

It has been estimated that it may take ten or more years for a community to recover to pre-disaster functioning levels. Interventions to improve mental health are aimed at reducing the length of time needed for recovery. As there will always be a gap between the resources available for individual treatments and the number of individuals in need, communities and researchers have sought to address this gap by providing interventions in schools.

Schools, including trauma-informed schools, have implemented interventions in order to reduce the symptoms of PTSD on affected children. Rolfsnes and Idsoe (2011) evaluated 19 studies from nine different countries. The traumatic events that the children experienced included political conflict, war, community violence, World Trade Centre attacks, hurricanes, earthquakes, and refugee status. The interventions were offered individually or in small groups. These interventions fell into four categories, but all categories involved some use of cognitive-behaviour therapy strategies. The four groups were: cognitive behaviour therapy (CBT), eye-movement desensitisation and reprocessing therapy (EMDR), play- and art-therapy and mind-body skills. The meta-analysis concluded that most studies had a moderate to large impact on reducing PTSD symptoms. However, as the evaluation noted, many studies did not report follow-up on the maintenance of treatment effects, and, in the three that did report follow-up, the follow-up period was three months. The promising part of the intervention that the authors noted was that school personnel could be trained to deliver interventions successfully that previously were delivered by registered psychologists, which meant that more children could receive treatment even in settings with insufficient registered psychologists.

A recent review of psychotherapies for PTSD identified elements common to successful therapies: These include psychoeducation for children and parents, teaching skills in regulating emotions and coping with stress, cognitive restructuring or making meaning of the traumatic event, and guiding the client to use imagination to understand and conquer their fearful responses (Schnyder et al., 2015).

Unfortunately, many children and adolescents with PTSD do not receive individual or small group treatments, and in some cases, do not attend therapy when it is available (Wamser-Nanney, Scheeringa, and Weems (2014) or fail to complete all of the therapeutic sessions. Of those who do complete treatment, one review (Hatton et al., 2004) reported that 56% of children with anxiety disorders improved (PTSD was considered an anxiety disorder at that

time). A review in 2017 reported recovery rates between 47.6% to 66.6% (Warwick et al., 2017). It is also noted that children can recover without receiving CBT.

According to these meta-analyses, the only effective treatment for children seems to be trauma-focused cognitive behaviour therapy delivered in multiple sessions by specially trained individuals. However, for this type of therapy to be effective, children may need to be at an age of cognitive development where they are able to discriminate their thoughts, behaviours, feelings and memories, and also able to remember, recall and discuss events with quite a high level of communication skills, as well as able to remember and implement strategies that require downward control from the pre-frontal cortex to the amygdala (see discussion in Chapter 2). Not all of the young children in the project with multiple PTS symptoms are yet at this developmental level. Even if children were at this level, the community does not have the resources or the number of trained professionals to provide multiple individual trauma-focused CBT sessions to the large number of children who have symptoms.

Thus, while there are promising treatments, particularly CBT with effects up to one-month post-treatment, none of these seems to have such overwhelming evidence (Gilles et al., 2013) that would justify their implementation across schools in the context of Christchurch.

Summary

Research reveals that PTSD can affect some young children by changing their biology and that it is very persistent unless treated. This is the most probable explanation for the increase in behaviour and health problems demonstrated in the present study.

The earthquakes period in Canterbury of more than 16 months, from the 09.04.10 Magnitude 7.1 earthquakes, through the 22.02.11 Magnitude 6.3 to the final recorded Magnitude 5.1 on 01.12.12 of this earthquake series encompassed more than a third of study children's lifespan by entry into school, and studies have shown that duration of exposure in much shorter-term disaster events is related to number and severity of symptoms in children (Swenson, Saylor, Powell, Stokes, Foster & Belter, 1996).

Post-disaster stressors, such as associated with rebuilding and recovery periods, are also thought to provide a continuing cascade of effects on the mental health of young children and their families, adding to the burden and reducing coping capacity (Alisic et al., 2014; Santiago et al., 2013). Even very well resourced public health campaigns have not been shown to reduce mental health problems in families, and individual or small-group therapy is not

available for all of the children who need it. Therefore, a different pathway is needed, and one that can be used by the schools to improve outcomes for many children in a single setting would seem to be the most efficient approach.

Figure 5.5. Redcliffs area above the former Shag Rock, showing ship containers as a blockage against falling destroyed homes on the top of the cliff (photo: Kathleen Liberty).

Chapter 6
School Environments and Sources of Stress

Children, parents, principals, teachers, assistants, staff, and school volunteers—all were feeling the effects of the accumulation of stressful events. As stress accumulates, everyone becomes less able to cope with the next trigger. In families and schools, if one person is feeling stressed and having difficulty coping, everyone around them will also feel the effects.

In a disaster ecology, where many individuals are coping with the burden of accumulated stress, there are many potential triggers of that next event—the one that can trigger negative coping.

Children's Stress Related Learning Problems

The primary function of schools is the education of children – and teachers are expected to lead teaching and learning. When teachers experience a loss of efficacy and confidence in their teaching skills, stress and burnout occur (Skaalvik, & Skaalvik, 2007). In a disaster-affected school, there are many sources of stress that can disrupt the learning-teaching interactions. A primary source of stress for teachers is how children's stress-related symptoms substantially increase the difficulties associated with teaching.

The Effect of Sleep Problems On Memory

Children with sleep problems associated with PTS will not consistently remember their lessons due to the effect of disrupted sleep on memory, and perhaps due to developmental disruption of cause and effect learning associated with implicit procedural memory (van Praag, 2004). Thus, teachers may become frustrated with the number of repetitions of instruction needed over time, and others may infer that the child has a learning disability, rather than a sleep problem. Research has shown that children with dyslexia also have sleep problems (Carotenuto, Esposito, Cortese, Laino, & Verrotti, 2016), and that sleep problems are associated with lower achievement (Sadeh, Gruber, & Raviv, 2002).

The Effect of Language Delay

Research indicates that children with PTS may have delayed language and learning capabilities (Thakur et al., 2015), thus reducing the effectiveness of strategies that are based

on the verbal transmission of ideas, directions, and instructions. Thus, instructing children with directions that involve multiple steps (e.g., "Get your book and open it to page 23") is likely to confuse children. Teachers will note that many children are only able to follow single-step instructions, similar to younger children.

The Effect of Impaired Concentration

Children will have difficulty attending to learning tasks in the classroom due to their PTS symptoms, the interruption of their cognitive processes due to intrusive thoughts, their confusion due to problems with short-term memory, and perhaps their lack of understanding of language (Shaw, Espinel & Schultz, 2012).

The Effect of Heightened Fear Responses

Children with the heightened fear response are also more likely to interpret neutral stimuli as threatening or negative. Thus, they are more likely to react to a teacher who has a neutral facial expression as if that teacher is angry or threatening because they misread facial expressions as being negative (Thomas et al., 2001). Also, experiencing or observing teachers reprimanding, correcting, or delivering aversive consequences will increase their fearful responses. Eventually, these children will likely be fearful of teachers' demeanour, tone of voice, or body language when they are delivering warnings or explaining negative consequences; this fear response will inhibit their ability to remember and act upon the teacher's directions and may interfere with their learning. Children with PTSD may also display more neutral facial expressions themselves, even in situations in which a happy or cheerful demeanor would be expected (Fujiwara et al., 2015, 2017).

The Effect of Other Children's Unpredictable Behaviour

An additional component of fear is that the unpredictable behaviour of other children may create the conditions of an unsafe environment. An unsafe environment is thought to further elevate reactive arousal symptoms (Del Gidudice, Hinnant, Ellis & El-Sheikh, 2012). Suggestions for teachers in "trauma-informed" classrooms describe the need to create a classroom with "physical and emotional safety" (e.g., O'Neil, George & Wagg, n.d., p. 3), which would include classrooms with few children with negative coping skills.

The Effect of Low Numbers of Children with Self-Regulation

All of these factors are likely to have diminished the effectiveness of the classroom behaviour management procedures. The fact that teachers were not able to rely on a previously valued

part of their teaching toolkit caused even more stress and dismay for children and teachers, not to mention parents who were also advised to use behavioural strategies at home.

One source of stress for teachers was in the experiences of many—that the strategies they had used successfully to teach children and help them learn to control their behaviour in school were no longer working. Many teachers felt burnt-out. Even the very best teachers will become discouraged when formerly effective strategies no longer were helping children and when, on average, each child had many behaviour problems. And many teachers were also losing sleep and having stress-related problems themselves (Carley, 2017).

Stressed teachers may themselves become irritable, withdrawn or have mood changes, and thus their interactions with each other, as well as children and parents, are impacted.

Strategies That Don't Seem to Work

The presence of stressed teachers, many children who were not sleeping properly, and many children with behaviour problems creates an overall school context that is full of potential triggers for stress-caused meltdowns, aggression, withdrawing, crying and other symptoms of dysregulation. It is to be expected that in such situations that schools turn to evidence-informed strategies to improve children's learning and behaviour.

One important source of stress for the teacher-child relationship was grounded in the apparent failure of previously successful strategies to be successful in the post-earthquake environment. These teacher and classroom strategies were developed in non-disaster communities and were effective in those communities, such as in the Pre-EQ Christchurch. The reasons why these strategies are not effective in the disaster-affected community are due to the biological and neurological effects of PTS.

Obviously, teaching and learning are critical activities in schools. However, the schools' experienced identified that many more children were struggling with learning as compared to the pre-EQ situation. Schools were pressured to improve government targets in terms of their measured learning outcomes in reading, writing and maths. This created a very stressful situation for Boards of Trustees, principals and teachers. In addition, parents' worry over their children's achievement impelled them to question teachers' skills and competence in regards to catering for their child.

Increasing Academic Time

In order to address this problem, many schools opted to increase the teaching time spent on reading, math and writing. Over this same time period, a national study showed that teachers improved their attention on those children who were struggling (Ward & Thomas, 2016). Despite this attention and emphasis, national standards have not had a positive impact on learning (Bonne, 2016; Thrupp, 2018) as overall rates of attaining national standards did not improve (Education Counts, 2017).

Increased professional development of teachers in the teaching of reading, maths and writing, and increased school time on these academic areas did not seem to improve results. The Ministry of Education's results for Canterbury showed the percentage of children failing to make the reading standard at Year 1 increased from 34.1% in 2014 to 38.7% in 2016 (Education Counts, 2017). For maths and writing, the failure rate after the first year of school increased from 13.7 to 15.6% and from 19.6 to 21.6% over the same period. Concurrently, the Christchurch South and East cluster of Resource Teachers of Learning and Behaviour provided support to additional teachers as referrals increased.

There are several potential reasons that children's learning did not improve. First, because of the relationship to arousal, increasing the classroom time spent in reading, math and writing in order to attempt to improve learning is likely to be counterproductive. Increasing the time spent learning will increase the stress and arousal levels of these children and may actually decrease their learning ability. This is likely to have an increasingly negative impact on their learning over time.

Second, increased stress may adversely impact on children's sleep, and more than half of the study children had sleep problems. As sleep is needed for memory consolidation, and stressed children have difficulty sleeping, the increased stress from pressure to learn could make learning worse by increasing sleep problems, reducing children's memory for what they had been taught.

Third, increased stress could negatively impact on children's ability to regulate their attention, making it more difficult for them to attend to their lessons.

As the teachers' best efforts at improving children's reading, maths and writing did not seem to be helping; it is virtually inevitable that teachers' stress increased, related to perceptions of role conflict, role overload and emotional exhaustion (Kuntz, Naswall, Bockett, 2013).

Treatments for ADHD, Conduct Disorder and Anxiety Disorders

In post-disaster environments, diagnosis of child mental health problems is often difficult, due to the overlapping nature of the symptoms, the stress on practitioners, and the lack of adequate resources to deal with the increased demand (Cohen et al., 2010; Crocq, 2002; Jabour, 2015).

Posttraumatic stress has important differences from general behaviour problems. In Canterbury, children with emotional and/or behaviour problems are most frequently classified by mental health services and treated as 1) ADHD, 2) Oppositional Defiant Disorder or Conduct Disorder, and, 3) Anxiety or Depression –mood disorder. However, children who have posttraumatic stress symptoms (PTS) have symptoms from each of these three diagnostic and treatment clusters Spitzer, Schrager, Imagawa, & Vanderbilt, 2017; Thabet, Tawahina, El Sarraj, Henely, Pelleick, & Vostanis, 2013). These include inattention and impulsivity, from the ADHD cluster, anger and defiance from the Conduct Disorder cluster, and negative mood changes and anxiety from the anxiety and depression category. Because the symptoms of children with PTS cut across these three commonly diagnosed and treated pathways, treatments, say, for ADHD (e.g., methylphenidate) are not likely to be effective for a child who has PTS, even though both may have concentration problems and be restless at school. Similarly, treating anxiety symptoms in a child who has PTS is not going to address the conduct disorder-type symptoms or the ADHD-type symptoms (Belivanaki, Ropi, KanariTsiantis & Kolaitis, 2017). Finally, parent training for children with CD, may not be

effective, because parent-delivered contingencies are not the cause nor the ‘cure’ for the child’s issues.

Overall, up to one-third of children with ADHD, Conduct/Oppositional Disorder or Anxiety who receive evidence-informed treatments in the community for these conditions do not respond to them, and this may be associated with individual characteristics, overlapping or co-morbid symptoms or possible failure to correctly diagnose the child’s condition (Currie, Stabile, & Jones, 2014; Hudson, Rapee, Lyneham, McLellan, Wuthrich, & Schniering, 2015; Michelson, Davenport, Dretzke, Barlow & Day, 2013).

In addition to the possibility of misdiagnosis, there are additional factors that weaken the impact of evidence-informed interventions for children with these diagnoses. These have to do with the context in which the children are attending school.

ADHD has a prevalence of about 2-5% of children, Conduct Disorder, has a prevalence of about 5%, and perhaps 2-18% of Anxiety disorder. However, since the symptoms of these conditions overlap with each other – a general guideline given to schools by the Ministry of Education is that about 10% of children in primary school will have a condition that is affecting their learning, requiring moderate, high or very high needs.

In the Christchurch disaster-impacted environment, study data show that the number of children with symptoms of these conditions is much higher. The number of children with problems in any classroom situation creates a much more challenging context for effective treatments. For example, while methylphenidate is effective in reducing symptoms of ADHD in many children during school (Van der Oord, Prins, Oosterlaan & Emmelkamp, 2008), the fact that the child with ADHD in the disaster-affected community has to cope in a school context in which many more children are having behaviour problems, may mean that medication is less effective (the child has to cope with many more distracting behaviours from other children, for example). Similarly, for children with Conduct Disorder, the classroom context may be more challenging, as many more children might engage in problem behaviour that might trigger aggressive responses. Finally, for the child with Anxiety, the presence of so many other children with unpredictable behaviour might increase their anxiety. Overall, the efficacy of accepted treatments for children with these conditions in a disaster-affected community has not been reported. Therefore, it is likely that the conditions that are present in a disaster-affected community weaken the effectiveness of treatements that were developed and trialled in non-disaster communities.

Traditional Behaviour Management and PB4L

Due to the high level of behaviour problems, teachers have been implementing classroom behaviour management strategies, including the Positive Behaviour for Learning programme in their schools, based on Positive Behaviour Support, facilitated by the Ministry of Education (Ministry of Education, 2015). However, teachers report that the common behavioural procedures, such as praising good behaviour, giving warnings, and using ignoring, procedural timeout, or point systems are generally not effective, and certainly much less effective than they were in the pre-earthquake classrooms.

The classroom management programmes based on behavioural principles, commonly used in schools, have not been successful in reducing behaviour problems, as shown in the data discussed previously (c.f., if they had been effective, the mean BPI score would have reduced instead of significantly increased). These programmes have been developed and trialled in communities in which perhaps 5-10% of children have high behaviour problems. They have not been trialled in classrooms in which more than half of the children have post-traumatic stress and hyperarousal symptoms or, at least, this has not been reported in the published studies of Positive Behaviour Support (e.g., Bradshaw, Mitchell, & Leaf, 2010). In fact, Professor George Sugai, one of the founders of Positive Behaviour Support, reported to me in a personal communication in 2015 that the procedures were not effective in traumatised schools in Sandy Hook, New Jersey, following a school shooting.

There are several overlapping reasons why classroom management procedures may be less effective in a disaster-struck community. First, the biological characteristics of post-traumatic stress disorder include disruption to memory processes (Van der Kolk, 1998). This would affect children's memories of the contingencies, such as praise or time out, which they experienced in the classroom. In addition, children with PTS are over-responsive to fear, and are more likely to perceive neutral facial expressions as angry faces (e.g., interpreting teachers who are delivering contingencies as being angry at them), which would further disrupt their learning of contingencies by increasing their arousal and decreasing information processing (Cacciaglia et al., 2017; Fujiwara, Mizuki, Miki & Chemtob, 2015; Rabinak, Mori, Lyons, Milad, & Phan, 2017; Zuj et al., 2017).

Behaviour management strategies are based on extinction learning (i.e., that the frequency of behaviours which are not reinforced will reduce over time). However, extinction learning is a function of the amygdala – the part of the brain that is dysregulated by PTSD. Therefore,

another reason that behavioural management procedures are not likely to be effective is due to the impairment of extinction learning (Cacciaglia et al., 2017; Guthrie & Bryant, 2006).

The effects of praise, rewards and reinforcement are also impaired by PTSD (Hannan & Orcutt, 2013); Sailer et al, 2008). Thus, children with posttraumatic stress symptoms may not learn even with praise and other reinforcers for their appropriate behaviour and ignoring or extinction of their problem behaviour.

Another basis for these management procedures is that the children have developed the ability to use the downward control from their prefrontal cortex to regulate their own behaviour; thus, children have the physiological ability to regulate their own behaviour. However, the biological effects of chronic stress indicate that it is this very area of the brain that has been dysregulated (Likhtik & Paz, 2015). Children simply are not able to listen to directions (language), internalise the meaning, and use it to control their own behaviour.

Another requirement for these management procedures is that children are able to learn improved behaviour from observing the good behaviour of all of the other children, and observing the reinforcement that these children receive. However, in the schools, the number of children who could be these models of good behaviour was greatly reduced, and many children had attention problems that meant that they were unlikely to notice the behaviour of other children when they were praised.

In addition, the children's memory for contingencies is affected by disrupted sleep. One of the key premises for contingency learning is that the consequence that the child receives on one occasion will increase (or decrease) the probability of that behaviour occurring in the future. This prediction is reliant on the child's memory for contingencies -- but this memory is disrupted by sleep problems associated with PTSD (van der Kolk, 1998).

There are many potential reasons that explain why behaviour-management type programmes are not effective for children with PTSD. These reasons should help teachers (and parents who are using behavioural strategies) understand why these strategies are seemingly not effective with all of the children in their classrooms.

Mindfulness

As schools have searched for alternatives to child behaviour and learning problems, mindfulness programmes have been heavily promoted by outside agencies. Mindfulness strategies have an intuitive appeal, as they may require little training to implement, may

appear to be effective in a short period of time, have downloadable apps for smartphones, and are associated with positive stories in the social media.

In addition, teachers may trial mindfulness strategies themselves and discover some personal relief from their own symptoms of stress. For instance, Taylor and colleagues (2016) evaluated a mindfulness intervention, MindUp, with 59 volunteer teachers in Canada. However, in comparison with the control group, the teachers participating in the intervention were already less stressed at baseline, but reported increased stress reduction during the intervention and nine weeks afterwards, as published in a journal about mindfulness. However, this study was not conducted at a school or community experiencing high stress or having teachers with high numbers of children with stress-related behaviour problems.

Similarly, Flook and colleagues in Wisconsin reported a study (2013) that used a version of Mindfulness-Based Stress Reduction training with 18 primary teachers, from four schools in a high deprivation area. This study also involved observing teacher behaviours including, for example, behaviour management, teacher sensitivity, and creating a positive classroom climate to determine if teacher use of mindfulness translated to creating a more peaceful classroom. They also measured whether teachers engaged in mindfulness, and reported that teacher spent on average of about 30 minutes per day in a formal or an informal application of skills they had been taught. The results showed a large effect for the reduction in teachers' reported stress symptoms, and a small effect in improved strategies related to classroom behaviour management. The mindfulness programme reduced symptoms associated with burnout in the teachers.

A more recent literature review (Boyd, Lanius & McKinnon, 2017), of individual and small-group mindfulness treatments for adults with PTSD, primarily military veterans, has indicated that mindfulness is acceptable to adult clients, perhaps related to the components that regulate attentional shifting from negative to the present moment, non-judgemental style that might reduce repetitive thinking and increase self-compassion, reducing reactivity to intrusive thoughts. The researchers review evidence of brain mechanisms related to mindfulness treatments. They conclude that mindfulness alone, or in connection with other treatments, such as cognitive behaviour therapy, can produce medium to high effect sizes. They suggest further research consider loving-kindness approaches in particular and point out that most studies are small, and have methodological issues – but still they find the promise of mindfulness interventions for adults is quite strong.

Mindfulness strategies for children in schools have also been studied, with a recent meta-analysis evaluating 24 studies in which children in years 1-12 were taught mindfulness. Zenner, Herrnleben-Kurz and Walach (2014) report modest effects on stress and resiliency, but no effects on emotional problems. This suggests that mindfulness may not be useful in reducing children's emotional problems. Since many children in post-EQ Christchurch do have emotional problems, this meta-analysis would confirm anecdotal reports that mindfulness will not reduce emotional problems.

Similarly, a small study of children in two classrooms was conducted in British Columbia (Schonert-Reichl et al., 2015). The children, who averaged ten years of age, were trained in MindUp (12 weeks, 40-50 minutes per week). They also had opportunities to practice gratitude, optimism, perspective-taking and kindness. The results showed that children reported they felt more empathy for others, had more emotional control and a stronger self-concept of themselves at school. They also reported that their peers were less aggressive. However, this study was not conducted in a disaster-affected school, with large numbers of children who have behaviour, sleep and attention problems.

> " . . . mindfulness has multiple components, requiring the activation of metacognitive knowledge, metacognitive monitoring and control, suspension of conceptual processing, attentional flexibility, and a de-centered relationship with thoughts." – *Adrian Wells, 2005*

Mindfulness for children has been studied with individual children who have experienced trauma or as a classroom-wide/school-wide resilience-building or prevention programme. These contexts are not the same as the current situation, in which it may be assumed that the majority of children in any classroom have experienced at least the extended trauma associated with the earthquakes and post-earthquakes disasters, and many of these are likely to have experienced additional events affecting them individually (e.g., school difficulties) or their families (e.g., divorce, flooding). Thus, the high numbers of children with PTS symptoms make the classroom climate difficult for the introduction of mindfulness. Children will find it difficult, for example, to close their eyes and think about breathing if they are afraid of what other children in the classroom might be doing. Or, the classroom might be noisy, and teachers might have to use negative behaviour strategies or reprimands to hush children – which can trigger fear and anxiety in children and reduce their capacity to learn. Similarly, children will find it difficult to pay attention to their breathing, for example, if other children in the classroom are talking, jostling one another, or unable to settle. Research

shows that children with PTS symptoms also can find it extremely difficult to understand and internalise verbal directions in order to exert control over their physiological responses. All of these issues are likely to reduce the effectiveness of mindfulness in a disaster affected community school.

To understand mindfulness, children must also have developed the skills involved in differentiating feelings from emotions, and in using language-based teacher-instructions to exert downward control on the amygdala in order to control their reactions and implement some of the mindfulness strategies.

In a disaster-affected community, even if children are able to learn mindfulness strategies, the overall classroom context has a strong possibility of reducing any effectiveness over time, for the same reasons, discussed above, diminishing the effectiveness of the other strategies. A Cochrane review reported that mindfulness type strategies were not more effective than other strategies, and, overall, any one strategy produced only limited short-term improvements in PTSD symptoms (Gillies, Taylor, Gray, O'Brien & D'Abrew, 2013).

A meta-analysis of mindfulness and related approaches concluded that "enthusiasm for promoting such practices outweighs the current evidence supporting them." (Greenberg & Harris, 2012).

Other Strategies

During the years since the earthquakes, schools have been diligent in trialling programmes from overseas with evidence-base (e.g., "Fun Friends") or without (e.g. "Roots of Empathy), and new programmes (e.g., Mindfulness). In addition, children have received counselling (e.g., for anxiety, bedwetting), small group support (e.g., Dinosaur programme, reading recovery), and respite care outside of the family home.

In addition, clinical psychologists working at local mental health clinics report that even though some children with severe symptoms referred for specialist treatment do respond to TF-CBT or Eye Movement Desensitisation and Reprocessing Therapy, the effects of the treatment are often not maintained in the post-treatment context (a recent Cochrane meta-analysis reported there was insufficient evidence that CBT delivered to children and adolescents was maintained for more than one-month post therapy – Gillies, Taylor, Gray, O'Brien & Abrew, 2013). This can be explained with reference to study results and to studies about the persistence of Posttraumatic Stress Disorder. Research indicates that PTS is very

persistent at any age (Fan et al., 2016; Piccardi et al., 2017) and some studies have reported that treatment, even if successful, may not be maintained at follow-up (Kolaitis, 2017).

There are several possible explanations for this. First of all, if the children who received TF-CBT or other interventions continued to have sleep problems associated with PTSD, this would be predictive of continuing problems with behaviour regulation, and TF-CBT and other approaches do not routinely include a sleep intervention. Second, the children would be attending school, and, if that school was similar to the study schools, they would be in classrooms where 1 in 5 children had high numbers of PTS symptoms, and more than half of the children had hyperarousal symptoms. That would make the classroom one with many stressors associated with many poorly behaved children who were struggling to learn, were unpredictable and often had angry, irritable or defiant outbursts. This environment would likely trigger the return of the PTS symptoms (AACAP, 2010) in the child who had received TF-CBT. This would make it less likely that the effects of TF-CBT, or other interventions would be maintained.

Summary

Since the disaster, schools have trialled many different evidence-informed strategies and kind, competent and caring teachers have tried their very best to help children learn. However, these strategies have not been effective for many children in the study schools, who are struggling with health, behaviour and learning issues, as explained above. Therefore, it is not surprising that so many of the targeted treatments and interventions implemented in Canterbury have not been as effective as hoped over the last three years.

This may be because the evidence that underpinned the choice of these interventions was not relevant to the present circumstances. For example:

a) Strategies with evidence from studies with children who did not have PTSD, for example, children with anxiety or learning problems;

b) Interventions with evidence from studies with individual children who were traumatised, diagnosed with PTSD, anxiety, ADHD, or other condition but not from a whole community struck by an extended series of traumatic events, or

c) Strategies from public health studies in non-disaster communities.

Overall, the lack of impact of credible strategies in teachers' toolkits has increased the stress that many teachers feel when faced with a classroom full of children with stress-related

symptoms. The teachers are further disappointed when even children who have received individual treatments and shown some improvement fail to maintain that improvement. The immense effort it takes to implement and sustain strategies, only for these not to work as well as hoped, adds to the teacher stress and feelings of burnout in classrooms with stress-affected children.

Environmental Stressors in the Classroom

The autonomic system, and, apparently, every cell in an individual's body, has a circadian rhythm that is sensitive to the time of day (Matsui, Pelle, Dong & Pemodel, 2016). This has been called the "body clock" and it apparently operates from the hyptholamus. The autonomic nervous system receives sensory stimuli, or cues, from the environment through the eyes, ears, nose, skin, and so forth, and uses these cues to regulate attention, body temperature, heart rate, breathing, and other autonomic functions such as sleep. Individuals with posttraumatic stress may process these signals differently or have more fearful reactions to them. Thus, environmental factors in classrooms become more salient in understanding how children and teachers perceive and interact with each other. Environmental conditions in the classroom, such as the time of day that children learn, eat and engage in activities, noise, temperature, and so forth, provide an environmental sub-text to the stress-related behaviours of children and teachers.

Subsequently, additional information was collected from schools about conditions that could trigger stress and hyperarousal to help identify strategies. As the research had identified the relationship between hyperarousal, behaviour problems and learning, information was collected on environmental factors that are associated with arousal.

Lee Hooper, a summer scholar with funding from the University of Canterbury and the Te Paeroa RTLB Cluster collected information from interviews with 35 teachers and classroom observations in November and December 2015 that informed an overall profile of the school environments.

Time of Day and Circadian Rhythm

One aspect of the autonomic nervous system that is disrupted by chronic stress is circadian rhythm – the 'body clock' (Rees, 2014). Therefore, principals and teachers were asked about events during the school day. According to the principals of the Strategy schools, the general timetable begins with some children arriving at school from 8 o'clock, and school starting at 9

o'clock. One school begins at 8:50 am. Children were reported to spend the time before school in activities on the playground. Some schools have breakfast programmes, but schools do not know which children attend these programmes.

The times of day that teachers find the most and least productive for learning were determined through the interviews. Teachers in New Zealand schools typically do not stand in front of a class. Instruction is delivered in small groups while children sit on the mats, or children work in small groups while teachers move about the learning space and support their learning (e.g., Valentine & Wilson, 1997). There was an almost unanimous consensus that the best times for academic learning were approximately between 9 and 11:30 in the morning. The most difficult times for classroom behaviour were late afternoons, before the end of the school day at 3 pm. In addition, most teachers reported that it was difficult for children to settle following breaks, such as after morning tea and lunch.

Teachers identified triggers associated with behaviour problems. Some teachers commented that some children are already upset and frazzled by the time school begins. A common trigger was that behaviour was affected by conflict and excitement on the playground during play times in the morning and at lunch, and "this spills over into the classroom". Other teachers explained:

- Children are tired and have done a lot already [at the time behaviour problems occur].
- Children may not have eaten enough lunch, as some eat a lot of [the food sent with them to school by their parents] at morning teatime.
- Hot temperatures in the classrooms, lunchtimes are long and chaotic, and there are fewer teacher aides in the classroom in the afternoons.
- There are low energy levels and high arousal, issues arising on the playground, hot or raining weather, and large gaps between eating times.
- Children are tired and hot at the end of the day.
- Sulking and crying, angry and defiant, are, at the end of the day, due to their age level.

Teachers aggregately reported some of the most important environmental contributors toward understanding the expression of PTS symptoms in a school context.

Many of the teachers mentioned that behavioural problems occurred during or after morning tea and lunch. Traditionally, morning teatime and lunchtime include a period set aside to eat

followed by a period play. This is typically followed by a set period of instruction and learning. Additionally, some teachers mentioned that children were hungry at the time the problems occurred.

The next step was to identify the timetable of morning tea and lunch. Some study schools have a healthy snack consisting of fruit and long-life milk for children at 9:30 am. For children at these schools, it can be estimated that most children would have breakfast (if they did eat breakfast) at 7:30 a.m., the healthy snack is two hours later. For children at schools who do not have a healthy snack, morning tea occurs three to three and a half hours after their estimated breakfast. Lunch-time at the schools varies between 12 and 1 o'clock, an hour and a half to two hours following morning tea, with play occurring directly afterwards at all but one school, where playtime occurs 50 minutes later.

Many children had parent-reported problems associated with eating. The identification of an association between scheduled eating times and behaviour problems provides a key factor to understanding the context in which behavioural problems are occurring in the Strategy Schools. Circadian rhythm is affected by the time of day that eating occurs and sufficient energy from food is needed for learning. According to Getlinger and colleagues (1996), "It is crucial that children of primary school age receive adequate meals to eliminate transient hunger, which may interfere with classroom performance. Proper nutrition has been linked to a readiness to learn, decreases in discipline problems, and increased alertness in the classrooms."

Thus, one important environmental context was the schedule of eating that seemed to be affecting children's learning, and energy levels.

Individual v. Group Learning

Stress is likely to affect how children perceive the behaviour of other children. Fearful reactions to other children may occur if the other children's behaviour is unpredictable, moody and/or irritable. For this reason, it is possible that children's stress levels might be higher if they were learning in small groups as compared to learning on their own (working individually), because of the likelihood that they would be interacting with a child in that group who had hyperarousal whose unpredictable behaviour could trigger a reaction, or whom the child might fear.

The stress levels of children working in small groups around a single table were estimated from finger-temperature detectors who volunteered to press the detector with their thumb.

These were also used to estimate the stress level for children working individually, whether on reading, math, or writing, or during discovery time, free time, or colouring in.

In small groups, around 29% of the children were calm, and 19.4% were stressed (the other children fell in between these two levels), while working individually, about 37.6% of the children were calm and 15.1% were stressed. These data indicate that children might be calmer when they are working alone, which may be because they do not need to engage with (other) children who are stressed. Alternatively, the degrees of stress and calm may be related to the children's energy levels.

Environment factors in classrooms were observed: decor, light levels, room temperature, and noise. These are environmental factors that are perceived by the peripheral nervous system and processed by the autonomic nervous system. Thus, these factors are related to hyperarousal, which is associated with the most significant cluster of behaviour problems affecting children in the study schools. These factors are also often overlooked in consideration of the effects of stress, with the predominant focus on individual educational and psychological factors.

Classroom Decorations

The use of decorations in classrooms may have started in the 1960s and '70s because of the research showing that children from poverty-struck families at that time lacked sufficient stimulation and so classrooms, particularly Head Start classrooms, were directed to enrich children's eexperiences.

The historical context is quite different to the current situation in which children are hypersensitive to stimuli (Naegeli et al., 2017). Recent studies have shown that classrooms that are overly decorated or cluttered, particularly with hanging objects or artwork, are associated with reduced concentration and learning for children with attention problems, as compared to classrooms with low levels of decorations (Barrett, Davies, Zhang & Barrett, 2015; Fisher, Godwin & Seltman, 2014). One of the symptoms of chronic stress is reduced attention, and highly decorated classrooms may exacerbate this problem for children with hypersensitivity to environmental stimuli.

Figure 6.1. Classroom decorations: "All About Me" balloons from http://nikau2015.weebly.com/connected-learning/all-about-me-balloons

An additional consideration is that 83% of study children saw falling objects during the earthquakes, according to their parents' reports. Hanging decorations in a fearful child's peripheral vision may be associated with an unconscious fear that objects above them will fall. The hanging decorations, flickering in the child's upper peripheral vision, may be a trigger for intrusive thoughts, a loss of concentration or other reactions associated with posttraumatic stress.

Approximately 94% of the classrooms were observed to have hanging decorations. All of the classrooms were more decorated than the minimum recommended in the reviewed studies. However, classroom decorations can also have an instructional purpose, such as providing cues information useful for learning (Imuta & Scarf, 2014), and using children's work to decorate classrooms may improve children's self -belief about the value of their work (Maxwell & Chmielewski, 2008).

Classroom Wall Colours

Many classroom walls were painted in dark colours, such as purple, magenta, dark blue and dark green. In addition, some classrooms were painted in intense brighter colours, such as red or orange, or had a single wall that was painted an intense colour. Studies that have evaluated wall colour have reported that children's achievement is lower in red-painted rooms as compared with green rooms (Elliot & Maier, 2012) and that children feel more excited in red and purple conditions (Brooker & Franklin, 2015). Pale blue has been associated with lower levels of arousal (Küller & Janssens, 2009).

Classroom Lighting

Light levels are thought to affect mood, in that brighter light is associated with increased dopamine and serotonin production (Golden, Gaynes, Ekstrom, Hamer, Jacobsen, Suppes, et al., 2005); serotonin is also hypothesised to have an important role in the overall functioning of the autonomic nervous system (Grider, Bertrand & Bornstein, 2017). Dim light may reduce hyperarousal levels and may also signal ‘sleep’ to the autonomic nervous systems of children who are tired, and teachers noted that turning off the lights or pulling the curtains across windows were sometimes used to quieten class activity.

However, dim light is not suitable for optimum learning (Sleegers, Moolenaar, Galetzk, Pruyn, Sarroukh, & van der Zande, 2012) and trying to learn in light that is too dim can result in headaches. The lux level needed for reading, writing, and tasks at desks or tables and for listening to teachers has been reported at a minimum of 300 lux in research studies (De Bruin-Hordijk & de Groot, 2010) and this is the standard for learning set by the New Zealand Ministry of Education (2007). However, the effect of shadow must also be taken into effect, with children sitting with their backs to the window, with lights directly overhead or to the rear, will be casting shadows on their own work, creating a micro-space of dim light. However, stronger light may be helpful. Focus lighting of 1000-lux at desk level has been shown to improve the reading of children in USA grade 3 who were struggling to learn (Mott, Robinson, Williams-Black, & McClelland, 2014). Also, bright light can affect positive moods. Sitting next to the window on a sunny day will provide more than the 1000-lux of bright light that is associated with full alertness and better moods..

Considering the overall level of light in about the centre of the classrooms, 51.5% of the observations were not in the acceptable range – light was too dim for learning. Considering only observations during purely academic times, two schools had acceptable light levels during all academic tasks, and two schools did not have acceptable light during any academic tasks.

Figure 6.2. Listening to a story. Kansas, USA (October 2012). (Photo Credit: http://cjonline.com/news-education-local/2012-10-01/topeka-schools-kick-new-reading-program).

Classroom Temperature

The classroom temperatures were sampled. The temperature considered acceptable for learning ranges from, in the winter, 20 to 24 degrees Centigrade and, in the summer, between 23 and 26 Centigrade, with adequate ventilation; however, equipment to measure ventilation and air quality ws not available. Given the changeable weather in November and December, a range of 20 to 26 degrees Centigrade, inclusive, was used to indicate an acceptable temperature. Children with dysregulated arousal may be overly sensitive to temperatures, both hot and cold because the autonomic nervous system regulates body temperature in relationship to environmental temperatures, so it's very important to keep the classrooms within acceptable levels, particularly during learning times. In addition, hot temperatures might increase irritability and aggression in children (Graetz & Goliber, 2002).

Observations revealed that 45% of the temperature samples were not within the acceptable range. In changeable conditions, such as November and December in Christchurch, it is not possible to always control the room temperature, but understanding how temperature interacts with arousal may give teachers information about the best times for learning. If temperatures in the range of 20-25°C can be reduced by 1°C, math scores might be improved (Haverinen-Shaughnessy & Shaughnessy, 2015).

Classroom Noise

Noisy classrooms are associated with lower levels of learning at all times, and also can reduce auditory working memory (Osman & Sullivan, 2014). In addition, noise stimulates higher arousal levels. A noisy classroom is very stressful for teachers, as well, as a teacher must speak an average of 10 decibels louder than the class in order to be heard (Pereira, Tavares, & Martins, 2015).

Noisy classrooms cause a number of stress and voice related problems in teachers. Noisy classrooms mean teachers have to talk louder and have to repeat themselves more often. They also tend to speak in a higher pitched voice when speaking louder or trying to get children's attention. One study, published in 2015 in the *Journal of Preventative Medicine and Hygiene*, reported that 85% of primary teachers had a voice disorder or voice problem (Angelillo, Di Maio, Costa, & Barillari, 2015).

Children with dysregulated arousal are likely to be more sensitive to noisy classrooms, as high noise can trigger a fear reaction, and they also will speak more loudly to be heard (Horn et al., 2017). Thus, noisy classrooms can act as a constant source of stress for children.

Figure 6.3. A reading class in the USA. (Photo Credit: U.S. Department of Education and US Chamber of Commerce. https://www.uschamber.com/above-the-fold/obamacare-makes-schools-race-find-more-substitute-teachers)

A noise level within the range of 35 to 40 decibels is considered to be optimum. The Ministry of Education has given 40 decibels as the level for open plan classrooms used in Modern Learning Environments. Children's normal activities of moving around, chatting, using materials, and so forth, contribute to the noise levels in an active learning environment. Because teachers must speak an average of 10-15 decibels louder than the class in order to be heard, noise levels can quickly rise. However, noise in combination with factors of the room's structure, such as the presence of noise-cancelling acoustic features, determined the impact of noise on children's learning.

One very important factor in the consideration of noise in a classroom is speech intelligibility – how easily the child is able to accurately hear what is being said. This is particularly important for children, who have not reached the developmental level at which they can block out unwanted sound. The further the child is from the teacher (or another child to which they are supposed to be working with), the more difficult it will be for the child to hear and understand what the teacher is saying. The ability to understand speech is also affected by the overall noise level in the environment. However, the closer the child is to the teacher, in general, the easier it will be for the child to hear what the teacher is saying.

One study reported that the background noise of an empty year four classroom was 43-52 decibels, including sounds from air conditioning and traffic outside (McCarty & Rollo, 2005). When all of the children were engaged in the same quiet activity of silent reading, the sound was 45dB – barely above the background noise. However, when children were working together and talking, the sound levels were 67 to 72 dB, about 20dB above the background noise. In that environment, a teacher would need to be speaking at 77 to 87 dB to be heard, and that level is not sustainable for the human voice. (An alarm clock might be around 80 dB, and a food blender is around 88dB. By comparison, a whisper is 30 dB, and normal conversation is 60-70 dB. 80 dB is 8 times greater than 70dB.). Thus, it also important as to the total duration of sound over about 56 dB, the level that is commonly reported when children are working quietly, and some talking is permitted/expected, and it is recommended that noise in an open classroom not be above 65dB (Shield, Greenland, & Dockrell, 2010).

Noisy classrooms can affect reading levels, and even a 5dB reduction in noise can improve beginning reading (Maxwell & Evans, 2000). In addition, noisy classrooms can reduce children's ability to work together and inhibit more complex conversational interactions – thus affecting some of the key aims of innovative learning environments.

McKellin, Shahin, Hodgson, Jamieson, and Pichora□Fuller (2011) reported that classroom dB ranged from 68-74, very similar to the observations in study classrooms. In that environment, they reported, teachers frequently had to call the children to pay attention "Listen here", for example. Children frequently did not understand directions, failed to follow directions or replied, "What?" Also, many children simply did not attempt to talk in noisy classrooms.

Noisy open-plan type classrooms are not suitable for K-3, according to Australian researchers, as "these results shown that "children's performance accuracy and speed decreased as noise level increased" and that "fully open plan classrooms are not appropriate learning environments for critical listening activities with young children due to their high intrusive noise levels which negatively affect speech perception" (Mealings, Buchholz, Demuth & Dillon, 2015). Therefore, it is important that in open-plan or innovative teaching spaces, noise is kept to a level suitable for learning.

In the Strategies classrooms, decibel levels were measured during the observed activities using a free application on an iPad (SPLnFFT Noise Meter). The average decibel level was 66, and ranged from: 49-80.6. The range of averages across the schools was between 61 and 71 decibels, although the measurement was not necessarily reliable, and did not take into account the ambient noise levels when the classroom was empty. However, it is important to note that an earlier study in New Zealand identified that more than 40% of primary children's ability to accurately identify speech in a classroom fell below 50% in classrooms with that noise level (Valentine & Wilson, 2002). Therefore, noise levels in Strategy School classrooms may be contributing to underachivement, and are likely to contribute to high levels of stress in the classrooms.

Summary

Overall, the profile of schools in the Strategy Project indicates that many study children have behavioural or health issues that are also related to learning difficulties. Teachers find it difficult to teach after lunch and also following breaks. Teachers have identified issues related to the timetabling of playground activities and hungry children that may be affecting behaviour.

Although teacher stress was not directly measured, studies have indicated that when teachers must deal with high numbers of children with behaviour problems, teachers themselves can become stressed. Caring teachers put every child first and don't take time for themselves. This

would be in addition to any residual stress from their own and their family's experiences of the earthquakes and the post-earthquake environment, or other factors affecting themselves or their families. Noisy classrooms also increased teacher stress in New Zealand teachers (Valentine & Wilson, 2002).

Researchers in Canada (Ferguson, Frost & Hall, 2012) reported the physical symptoms associated with teacher stress included exhaustion, increased blood pressure, difficulty sleeping, headaches, nervousness, panic attacks and cold sweats, and autoimmune diseases, such as irritable bowel syndrome. Psychological symptoms include depression, feeling unable to cope, feeling very angry, and anxiety. The two most significant factors that predicted teacher stress were high workloads and poor student behaviour. In the post earthquake environment, Strategy Schools have both. High workloads for teachers are associated with the high number of children with learning and behaviour difficulties (Friedman-Krauss, Raver, Morris, & Jones, 2014).

Similarly, for principals, a 2005 study reported that 40% of New Zealand principals were stressed or highly stressed and working 50 or more hours per week (Hodgen & Wylie, 2005). That was over 10 years ago. A study of primary principals in Ireland, published in 2016, indicated that high numbers of pupils with emotional and behaviour problems, and high use of disciplinary measures, were associated with higher levels of principal stress (Darmody & Smyth, 2016).

Children with stress, not sleeping at night, or learning to their potential in school. Parents worried and upset by their children's struggles and health problems. Teachers and principals, trying their very best and not succeeding; a community in their fifth year of continual stress in addition to the normal stressors in non-disaster communities – these are the elements of a perfect storm and create a context in which innovative strategies may offer some hope for improvement.

Figure 6.4. The Restart Mall, Christchurch. (Photo credit: Kathleen Liberty)

Chapter 7
Strategies: Foundations and Criteria

The principals of the Strategy Schools were very concerned about children's underachievement and were well aware of the patterns of children failing to meet the national standards. They felt that not only were too many children failing to meet the national standards but that children who WERE meeting the standards were also still not achieving at their actual potential. However, schools and teachers, whilst acknowledging the difficulties with children's learning, were at a loss as to how to address these problems.

School-level Intervention is Required

The number of children in a disaster-affected community who need support for the well-being of their mental health leads to the conclusion that school-level interventions are required (Bonanno et al., 2010; Norris, Friedman & Watson, 2002).

The Strategies Project followed directly from the conclusions drawn about the behaviour and learning problems of the study children, as informed by the literature review. The goal was to develop or identify innovative strategies that might improve children's learning and behaviour in schools in the earthquake and post-earthquake stressed environment.

The strategies that were implemented were discovered through a process guided by theoretical and context-dependent criteria described in this chapter to inform their acceptability to the school and community context.

First, the strategies had to fit within the national bicultural context of New Zealand, as established by the Treaty of Waitangi.

Second, recommendations must suit educational considerations of conditions at the study schools and within the context of learning in New Zealand schools.

Third, the strategies had to be appropriate to the age of the children and their development.

Fourth, strategies had to fit with the psychological research into the effects of natural disasters on children.

Fifth, strategies had to fit within models of well-being – that is, promote well-being rather than focus on deficits.

Six, strategies had to have at least some research evidence that a key aspect of children's mental health and well-being was improved through implementation of the strategy.

Seven, strategies had to fit with the biological impacts of trauma on young children.

The school communities determined the acceptability of the strategies.

Criterion 1: Treaty of Waitangi

The principles of the Treaty of Waitangi, participation, partnership, and protection were involved in the selection of strategies, which were discussed with Māori colleagues during the development of the strategies. However, the schools will determine if the strategies are appropriate within the bicultural contexts of their own charters. Adhering to the fundamentals of Te Whare Tapa Whā will also demonstrate the commitment to Treaty principles.

Te Whare Tapa Whā

Te Whare Tapa Whā is one Māori model of well-being that metaphorically rests on the four walls of a whare, as described by Mason Durie (1994: Ministry of Health, 2017a). These "walls" are Taha Tinana, Taha Wairua, Taha Whānau and Taha Hinengaro. Although these terms are not really easily translated into English, one way of thinking about these as representing the dimensions of physical health, spiritual health, family health and mental health.

The whare model is a reminder that well-being is not something that can be parcelled out or divided up. Health is not just a physical condition related to the corporeal body; it is a holistic experience within each individual that encompasses their relationships within their family and family group and community.

It is also a reminder of the definition of health from the World Health Organisation (2017), that health is not merely the absence of disease; it is a state of complete physical, mental and social well-being.

This model is also a reminder that it not enough to consider only one aspect of stress, but strategies must seek to improve holistic well-being.

Ka Hikitia

Next, New Zealand schools have priority strategies within the framework of *Ka Hikitia, Accelerating Success 2013-2017,* which addresses improving how education performs so "that all Māori can achieve and be proud of knowing they are Māori". The principles that underpin Ka Hikitia include an understanding of the three pillars of the Treaty of Waitangi, partnership, participation, protection, the principle of Ako, shared learning between children and teachers and teachers deliberately using evidence-based practices (Ministry of Education, 2013, p. 16). Achieving Māori potential is positively based on collaboration and co-learning with high expectations for Māori, and does not focus on deficits or remediation. *Ka Hikitea* recognises that the identity, culture and language of Māori are positive assets for learning. The strategies identified must be those that fit within this essential New Zealand context.

These components are crucial to ensuring that recommended strategies have a cultural fit with New Zealand.

Criterion 2: Educational Contexts

There are multiple educational considerations. New Zealand state schools adhere to a national curriculum, and children's progress in reading, writing and mathematics are measured annually and compared against national standards.

National Curriculum

The National Curriculum, for English-medium schools and Te Marautanga o Aotearoa, for Māori medium schools, consist of guidelines and directions for schools in establishing their curricula. The vision is "for young people:

1. *Who will be creative, energetic, and enterprising*
2. *Who will seize the opportunities offered by new knowledge and technologies to secure a sustainable social, cultural, economic, and environmental future for our country*
3. *Who will work to create an Aotearoa New Zealand in which Māori and Pākehā recognise each other as full Treaty partners, and in which all cultures are valued for the contributions they bring*

4. *Who, in their school years, will continue to develop the values, knowledge, and competencies that will enable them to live full and satisfying lives*
5. *Who will be confident, connected, actively involved, and lifelong learners."*

Thus, the aim was to find strategies that would fit with the overall vision of the New Zealand curriculum. One important part of the New Zealand Curriculum is the creation of a supportive learning environment, and that was a key component of the criteria that were identified for the project.

National Standards

Alongside the National Curriculum, the Ministry of Education mandates that schools provide yearly data on children's progress against the National Standards in reading, writing and mathematics. Teachers use a range of information to make informed judgements about children's progress, following the National Standard guidelines (Ministry of Education, 2010). The study schools provided evidence that many children were not meeting national standards and one goal of the strategies must be to support children's learning.

Positive Behaviour For Learning (PB4L)

Positive Behaviour for Learning (PB4L) is an initiative that has been introduced systematically in New Zealand with support to schools by the Ministry of Education, in cooperation with the Ministry of Health. The foundation of PB4L is USA research on Positive Behavior Support. PB4L is focused around using strategies from operant learning paradigms to shape and maintain positive behaviour and consists of a number of steps that are implemented by schools. The first initiative in implementation of PB4L is a change in the school environment, systems and practices to emphasise positive behaviour development. Strategies such as expulsion, suspension and stand-downs are considered reflectively, and individual strategies to promote positive behaviours are brought in to replace any exisiting negative discipline practices. Schools apply for Ministry support to become part of the PB4L network and, if approved, their implementation is supported by the Ministry of Education over the long term. Three of the strategy schools are PB4L schools, and project strategies must fit within this context.

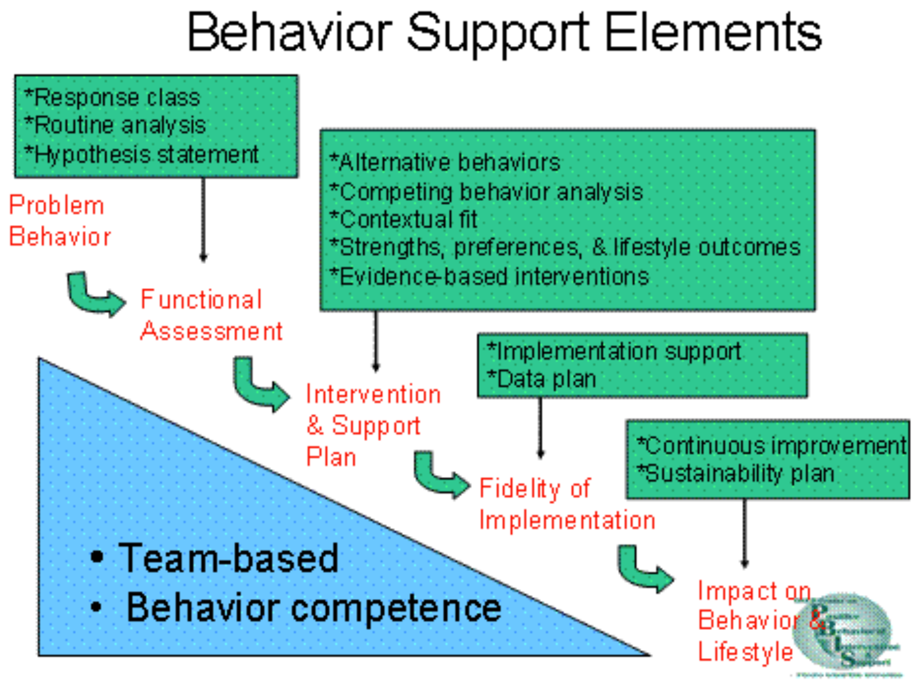


Figure 7.1. Diagram of the tier of intensive positive support. .From the US Department of Eduation, OSEP Center on Positive Behavioral Interventions and Supports, https://www.osepideasthatwork.org/node/108

Inclusive Schools

Strategies must fit within the inclusive processes, that the inclusion is mandated for all of New Zealand. Thus, the strategy must not involve removing a child from the classroom, or 'outsourcing' children with problems, but needs to involve an appreciation of diversity and strategies that are suitable for every child.

About inclusive education

Inclusive education is where all children and young people are engaged and achieve through *being present, participating, learning* and *belonging.*

Figure 7.2. A definition of inclusive education from the Ministry of Education. (Source: http://inclusive.tki.org.nz/about-inclusive-education/).

Innovative Learning Environments

The Ministry of Education introduced a strategy aimed at promoting innovative, modern, collaborative learning environments (Ministry of Education, n.d.; Osborne, 2016). The goal was to increase the flexibility of learning environments while improving their physical quality, and is being rolled out gradually.

Implementation and Resourcing

There were a number of considerations in identifying recommended strategies. As the primary aim of schools is education, recommended strategies must promote learning. However, given the constraints in the community, strategies must be "doable" for principals and teachers without adding to their stress levels; it must use skills currently in the teachers' flax basket, and it must not draw on the schools' limited resources. These are very stringent criteria for their educational considerations.

Criterion 3: Age Appropriateness

The next criterion established for strategies was that they needed to be appropriate to the chronological and developmental ages of the children and fit with the developmental status of children, taking into consideration the effects of trauma on

- Cognitive development
- Physical development
- Language development
- Socio-emotional development and self-regulation
- Development as a learner
- Development of well-being

As disasters can impact on children's development, and as some indicators have suggested that some children might not be meeting developmental milestones at the age-expectant points, strategies must be sensitive to making sure that children are not being expected to respond or act at a level beyond their current capacity.

Criterion 4: Psychological Research on Disaster Effects

The evidence from psychological research about how children's learning and behaviour is affected by traumatic stress and by disasters is very compelling (see previous chapters). Strategies needed to be consistent with this body of evidence.

Criterion 5: Ecological Well-being

Ecological contexts describe the overarching aspects of community and situation in which the strategies will be placed. There are two vital approaches to understanding and contextualising the strategies. The first is Bronfenbrenner's Ecological Systems Theory, and the second is Te Whare Tapa Whā.

Ecological Systems Theory

Bronfenbrenner's Ecological Systems Theory has set the foundation for organising all of the elements that impact on a child's development (Figure 7.1). In this system, as illustrated in the diagram, the child is one element of the micro-system. This also includes the child's family and their schools.

And this is a very, very important concept for determining strategy implementation in the project.

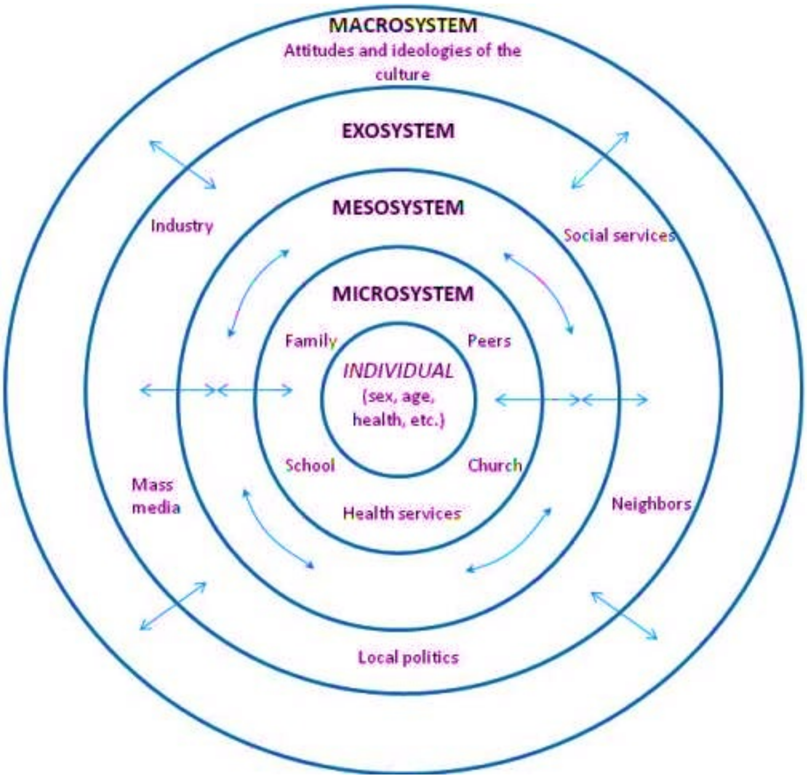


Figure 7.3. Diagram illustration of Bronfenbrenner's Ecological Systems Theory.
By Hchokr at English Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=50859630

The approach of implementing an intervention in for an individual child in a school situation when over half the class might have arousal symptoms not only fails the inclusion criteria, it is also very likely to be counterproductive. Even if a child is able to benefit in a one-to-one session or a small group session outside of the classroom — for instance, in attending therapy for PTS symptoms — trying to transfer whatever has been learned or whatever behaviour strategies have been developed into the classroom context of 50% of children with arousal means that maintenance of any gains is very, very unlikely. So a much larger aim is needed – to first reduce the overall arousal level in the classrooms before individual interventions or strategies that will actually be effective and be maintained can be implemented.

Public Health Model

The evidence-base for strategies to improve well-being of individuals affected by Post-traumatic stress symptoms focuses overwhelmingly on strategies to be delivered to individuals, such as Eye Movement Desenstisation and Reprocessing, CBT, or Psychotherapy or to small groups, such as small group CBT. However, the basis of such strategies is that there is an individual or small group with PTS who live within an overall population, which, it is assumed, does not have PTS. This 'external' population is seen to be available to able to provide services and supports to improve well-being. However, no study has been identified that recognises that therapists, service providers, teachers, and other professionals in a disaster area are likely to themselves have PTS symptoms following a large scale extended period of disaster. In fact, planning for the mental health of populations in post-disaster cities has been recognised as a gap in the research literature in regards to disaster planning and preparedness (Davidson, & McFarlane, 2006; Goldmann & Galea, 2014; North & Pfefferbaum, 2013).

Public Health Approach

In contrast to the resilience perspective, which focuses on delineating resources and protective processes that promote healthy outcomes among individuals or families facing adversity, the public health approach to prevention focuses on how to change population-level behaviors, environmental factors, or processes to reduce incidence rates of disorders (i.e., number of new cases) and to increase healthy outcomes in a population (Rose, 1992). To effectively impact population-level outcomes while addressing individual differences (i.e., varying levels of adversities, resources, and problems), the public health model incorporates multiple intervention levels: mental health *promotion* interventions to enhance well-being of the general public or a whole population, *universal* prevention programs to prevent disorders in the general population or in a whole population that has not been identified based on individual risk, *selective* interventions for those at-risk due to exposure to specific adversities, and *indicated* programs for individuals experiencing sub-diagnostic symptomatology (National Research Council and Institute of Medicine [NRC/IOM], 2009).

A public health approach generally follows the ecological systems model, with a tiered system. In a pyramid model of three tiers, the top tier (or the bottom tier, depending on organisation of the pyramid) consists of intensive interventions delivered to individuals, the middle tier consists of less intensive interventions delivered to targeted groups, and the bottom tier consists of preventative interventions universally delivered to everyone. The evidence-base for strategies in a disaster-struck city is strongest at the 'top' tier – individuals, with little or no evidence for the 'bottom' tier of strategies – which, in a disaster-struck city,

would focus on preventing the development of additional or following mental health problems due to the accumulation of adverse events. As natural disasters are generally not preventable, interventions have turned to therapeutic, instructional and intervention strategies to increase individual recovery from or coping with, the adverse experiences that will occur following the disaster event (Winslow, Sandler, Wolchik and Carr, 2014).

Criterion 6: Evidence-Informed Strategies

The final criterion for the identification and selection of strategies was the requirement that strategies have some evidence base that it had a beneficial effect on children as well as fit within the above criteria. Thus, the identified strategies are ones that have published research evidence as to their impact. One important consideration related to strategies associated with trauma-informed schools.

Trauma-Informed Schools

Information about the impacts of trauma and the Adverse Childhood Experiences Study (see Chapter 1) started a transformation of health-care, homeless shelters, emergency-room response, child-welfare, psychiatric services, first-response teams, the juvenile justice system, and education in the USA. In New Zealand, information and resources are available through Te Pou o te Whakaaro Nui (2017), Ashmore (2013). The Werry Centre (http://www.werryworkforce.org/elearning) and Engage (http://www.engagetraining.co.nz/trauma-informed-training.html). This movement is known as the Trauma-Aware Schools movement (e.g., https://traumaawareschools.org/about). It is also known as Trauma-Sensitive Schools), and is now present in many countries, including Australia and New Zealand.

One outcome of ACE and related studies is that the results raise a number of issues for schools. Most teachers do not have training in understanding how adverse and traumatic events affect children's learning and behaviour. However, it is very likely that all teachers have had a child tell them about one of the events appearing on the list above. Some teachers will have experienced adverse events themselves that may be triggered by hearing about an event from one of their pupils. Most teachers will react to children's experiences intending to help or comfort the child, but may unwittingly cause additional stress. Some teachers may dismiss or discount the child's reports. Many will not associate the child's problem behaviour or learning difficulties with the traumatic events. School policies may discriminate against children who have experienced adverse events by, for example, suspending them or expelling

them from school, which can produce even more problems, such as violent offending (Crooks et al., 2007).

The Trauma-Informed Schools approach involves a number of steps. One of the first steps is the professional development of all staff to understand how adverse experiences affect children's learning, behaviour and development (Australian Schools Foundation, 2010; Blodget & Dorado, 2016). This understanding is used to transform school practices to take into account the effects of trauma. There are many other school practices that are involved in the process of becoming trauma-informed. For example, teachers learning how to respond to emotional behaviour with a strengths-based and resilience-building approach, children learning coping skills, schools providing mental health services, and changes to disciplinary procedures.

Some states in the USA, such as Connecticut have adopted a ten-year plan to transform practices in all of the schools and all other agencies, including hospitals and health centres, that are involved with children, including professional development, screening, diagnosis and interventions (Franks, 2013). In California (Figure 7.4), a lawsuit filed in May 2015 seeks to require that all schools in the Compton school district become trauma-informed (Paull, 2015).

Research on the overall effects of trauma-informed schooling has been published for more than twenty years. A meta-analytic review of 19 studies of school-based interventions conducted by Rolfsnes and Idsoe (2011) included seven studies that involved schools in communities hit by a disaster (four Hurricanes in the USA, and two earthquakes, one in Turkey and an earthquake and tsunami in Sri Lanka). The interventions reported included individual and group narrative, manualised or CBT-based therapies delivered in school settings by specially trained staff, for children aged 8-16, and these interventions reported a medium to large effect size. However, these studies were simply using schools instead of mental health centres as a setting to deliver TF-CBT and similar interventions.

For example, one intervention promoted for a Trauma-Aware school context is CBITS (Cognitive Behavioural Intervention for Trauma in Schools) [National Child Traumatic Stress Network, 2004], and simlar CBT-based groups. This intervention requires highly trained professionals, is offered to small groups over 8 to 10 weeks, and there is little evidence that it

Figure 7.4. The headline from the announcement by the *ACES Too High News* about a legal suit filed by four students against a California school district. For more information, and to listen to the students discussing their situation, please visit Paull, S. (2015, May 18). https://acestoohigh.com/2015/05/18/landmark-lawsuit-filed-to-make-trauma-informed-practices-mandatory-for-all-public-schools/

is effective in a natural disaster-impacted community or that it addresses the biological issues associated with PTS. For example, Powell and Thompson (2016) reported on "Journey of Hope" CBT-based intervention delivered in schools for 102 children in a community affected by tornadoes. Although methodological issues discussed by the researchers influenced results, children did show improved coping and prosocial skills. However, inattention, peer problems, conduct problems, and emotional distress did not improve. These results indicate that the children's HPA-arousal symptoms were not addressed by the intervention. The authors note that many participants were from poverty-stricken neighbourhoods and had likely suffered multiple traumas, which is one reason given for the lack of change in some variables. However, the results of this study are indicative of general limitations in the school-based intervention literature.

The March 2016 special issue of *School Mental Health* was devoted to trauma-informed schooling, but this issue includes only three case studies (Overstreet & Chafouleas, 2016). One of the limitations of the research identified in this special issue is that the development of

trauma-informed schools is a lengthy process, and, to date, research has not indicated its overall effectiveness in natural disaster community. Although the case studies are interesting, there is little evidence in regards to our current situation, in which most of the population has been exposed to multiple natural disaster events.

A very recent review of the literature on school-based intervention in trauma-informed schools pointed out that interventions were delivered by non-school personnel to only selected children in a school, and did not examine the acceptability of the intervention, whether it generalised to helping the children cope in other settings (e.g., at home), and whether it maintained (Zakszeski, Ventresco & Jaffe, 2017). In addition, there were serious methodological limitations. The researchers concluded that the evidence for these types of approaches is limited but promising.

Thus, a research search identified that there were no school-based interventions with a strong evidence base and failed to identify any arousal-reducing strategies with a strong evidence base for children aged 5-10 with post-traumatic stress disorder or post-traumatic stress symptoms that can be delivered in a school setting in a disaster-struck community. Although there may be promising strategies implemented in school settings, such strategies were designed for small groups of children who had experienced trauma.

The community does not have the resources for highly trained professionals to deliver individual or small group strategies to all the children in need. In addition, schools in the community have implemented many different strategies since early 2011, including both individual therapies provided to children with the most severe needs and school-based anxiety coping strategies and new methods of classroom management of behaviour problems. However, principals and teachers report that these strategies have not been effective, or, if effective, changes have not been maintained. This is borne out by the evidence from the study teacher and parent reports.

The majority of study children in the participating schools have at least one symptom of post-traumatic stress, and, in one school, more than 3 out of every 4 children have arousal symptoms. The community needs a school-based strategy that can help many children at once.

As CBT was the most-evidence-informed strategy for individual children, the components of CBT were examined to determine if components could be incorporated into strategies. Schnyder and colleagues investigated the common elements of psychotherapies (2015) and

identified the following component elements: psychoeducation; emotion regulation and coping skills; imaginal exposure; cognitive processing, restructuring, and/or meaning-making; emotions; and memory processes. In considering these processes, the first step to establishing a context for psychoeducation, emotion regulation and coping skills would be to reduce overall behaviour problems. Logically, a classroom with fewer children with behaviour problems would provide the first step in creating a calmer context for psychoeducation to occur. Stressed children will benefit from a calm environment. “For some children, schools might be the only place where there is consistent calm, and teachers might be the only adults who teach them the calming strategies that they will rely on for the rest of their lives” (Tranter & Kerr, 2016, p. 3).

Within the criteria for evidence-informed strategies, the next part of the discovery process was to identify interventions that addressed the underlying neurobiological dysregulation that was expressed in child behaviour problems.

Criterion 7: Neuro-Biological Considerations

As the aim of the first set of strategies was to reduce the arousal level and associated behaviour problems in schools, the strategies must fit within the information on the biological effects of stress. These have already been discussed in previous chapters, but, in particular, the parts of the brain, the amygdala, the hippocampus, and the prefrontal cortex are likely to be affected in children with arousal symptoms. This means that they might respond unpredictably to new stimuli and events in their environment and this makes it very, very difficult to consider what types of interventions might be effective.

In addition, it has been shown that the prefrontal cortex is not communicating very well with the amygdala in stress-affected children. As the prefrontal cortex is where the language is processed, and the amygdala is controlling children's reactions to these new stimuli, interventions that are based on language, for example, the teacher telling the child what to do, are not really going to be effective. And specifically they won't be effective until arousal levels are reduced.

According to Koss and Gunnar (2017)

> At any point in development, chronic activation of the system will produce alterations in the axis that persist until the threat is alleviated and the system has had time to return to normal functioning. In contrast, sensitive periods are times when stimulation influences the set points of the system in ways that persist long after those influences are removed. Thus, sensitive periods are not supported by merely finding that

> adversity at a particular developmental period predicts cortisol activity, but rather these predictions hold long after adversity has remitted. Finding that the same conditions experienced at one time rather than another have long-lasting consequences provides even stronger evidence. In human studies, limited evidence to date points to prenatal and early postnatal years as sensitive periods for the HPA axis.

Therefore, as one of the overarching aims of the first step of the strategies is to reduce overall arousal levels, it is critical that strategies fit within the physiological knowledge base. The three major biological principles that guided strategy selection were:

- Environmental stimuli that can trigger stress symptoms and reactions are important considerations and need to be addressed.
- Dysregulated biological processes from the Autonomic Nervous System need to be re-regulated before memory and learning can improve.
- Language-based interventions which need to be processed by the prefrontal cortex and passed down to the amygdala, are not always going to 'get through.' This implies that there must be reduced reliance on strategies that involve talking to the child or giving verbal directions.

Criterion 8: Quality Assurance Processes

The identification and implementation of a criterion-based quality control process established

> The fact that states like hunger, fatigue, or illness, all produce the same signals as emotions like anger, anxiety, sadness, or anxiety, emphasises the importance of looking after your body as a way to stabilise your mood. *Robson, 2017.*

a system for quality control (Manghani, 2011). Several processes were implemented in addition to the above criteria to assure the development of quality resources.

First, New Zealand professionals were consulted. The process of developing strategies was discussed with John Crawshaw Ministry of Health appointee to the Canterbury Earthquake Recovery Administration, and for Canterbury Mental Health; Colin Hamlin, the Ministry of Health Chief Advisor for Child and Adolescent Mental Health; and Harith Swadi, the Canterbury District Health Board's Director of Child and Adolescent Mental Health. In 2015, they all affirmed the need for community-level, school-based interventions for children of primary school age. Second, the preliminary recommendations were discussed with mental health and educational professionals in an Advisory Board and including Māori professionals.

Third, the acceptability of the recommended strategies was ultimately determined by whether the school community – the Board of Trustees, Principal, Teachers and Support Professionals, and Families– supported and actioned their implementation. This process incorporated not only the evidence-informed recommendations as described in the next chapter but the knowledge from "practice-based evidence" present in the school community.

Practice-Informed

While evidence collected during controlled research trials may reveal promising interventions, until those strategies are able to be successfully implemented in the 'natural environments" of schools, such strategies are lacking in practical evidence. Most intervention studies published in international journals use highly trained non-school employees to implement strategies and the implementation is overseen and controlled by researchers. Thus the evidence on which the strategies are based does not conform to the "natural" environment of schools. In addition, many strategies "disappear" from schools when researchers or special clinicians leave.

There are many barriers to the translation of research-based strategies into schools (Gersten & Dimino, 2001; Glasgow & Emmons, 2007), and practitioner knowledge of the educational context of their school is the ultimate test of whether a recommended strategy is perceived as useful and doable. In the present project, the expectation was that strategies be implemented by the school community, not by researchers or community mental health teams. Thus, whether or not any recommendation was implemented revealed the overall validity and acceptability of that strategy, including its acceptability to Māori, fit within the school charter, and its 'doability." Thus, completing the quality-reviewed process was controlled and determined by the school community.

Stepwise Strategy Implementation

It is evident that the challenges facing children, families and schools are of a long-standing nature. Thus, it must be recognised that it will take a long time to change the trajectories to assist children in improving their health and well-being. It is also important to realise that changes to schools are lengthy and involved processes, and that all points in the system are suffering from stress. Therefore, the strategies were conceptualised in a tiered process, aligned with a public health model.

Step One Strategies

The first strategies aimed to reduce the overall arousal levels in the classroom and improve teacher well-being. Until the arousal levels are reduced, children's learning and the development of self-regulation and control over their own behaviour will be impeded. Concurrently, parents of children with extremely high levels of arousal would also be encouraged to implement strategies.

Step Two Strategies

The second step for schools with positive results from Step 1 strategies would be encouraged to continue these strategies, and additional strategies to reduce stress would be recommended. At this time, teachers can be trained in resilience facilitation procedures, based on the Pennsylvania State University's Resilience Programme. The Reaching-In Reaching-Out Resiliency Training Programme for Service Providers (RIRO) strategies have been specifically designed for young children and their teachers to build positive relationships toward resilience and coping skills (Pearson & Hall, 2017). Another important strategy is to improve children's sleep through a sleep education programme that involves the children as learners with support from their teachers and parents. This programme would also include support from a clinical psychologist for the most affected children as determined by their parents. Quality sleep is a requirement for memory consolidation. These two strategies should further enhance the children's well-being. (These strategies will be explained in detail in a subsequent publication).

Step Three Strategies

The third step must invole schools continuing to implement step one and step two strategies. The calm environment that would have been established at this time would be maintained, and interventions for children with the highest level of arousal would be implemented within the classroom context, and as would interventions designed to improve self-regulation. That is, teaching children how to control their own behaviour, how to solve problems without reactive behaviour problems and how to help their peers when they are stressed. For example, children need to learn how to deal with other children who are unpredictable, and how to modulate their own responses. Step three interventions might be implemented following the sleep education programme. At this time, there can be class-wide interventions to improve children's ability to learn in small groups and to work successfully individually.

Chapter 8
Step One Strategies for Schools

The first set of strategies is an innovative approach to reducing behavioural symptoms of PTSD in school classrooms with the aim of promoting calm classrooms. These strategies are described in this chapter.

1: Improve Teacher and Principal Well-being

The strategies to be recommended to the schools begin with the first strategy – stress reduction strategies for teachers and the principal at each school (Darmody & Smyth, 2016). There's quite a bit of research about teacher stress, and the relationship between teacher stress, mental health problems, anxiety and depression, and their job satisfaction. Child behaviour problems are the single best predictor of teacher well being. Child behaviour problems predict teacher stress and classroom emotional climate as shown by Friedman-Krauss and colleagues in 2014. The higher the number of behaviour problems, the higher the degree of teacher stress.

However these studies have not been conducted in the context of a disaster community, so they are probably underestimating what's happening in the community. A recent article in *Biological Psychiatry* has pointed out how post-traumatic stress can affect the immune system and is implicated in autoimmune diseases (Benros, 2015), and there is sufficient evidence as for concern about the health of teachers and principals exposed to years of stress.

Figure 8.1 Biomedical stress detectors from Bio-medical Instruments. *38875 Harper Ave. Clinton Township, MI 48036, USA.*

It was found, coincidentally, that teachers were not aware of their own stress levels. When teachers were given stress detectors (Figure 8.1), almost invariably, the teacher's test would come out showing high stress (based on finger temperature). When this happened, the teachers would laugh and think that there was something wrong with the detector (e.g., "This is broken",

“Mine doesn’t work”). This is a common response by stressed adults to questions about their own stress levels. People who are suffering from stress and stress-related disorders that are affecting their body may not be entirely aware of their own stress levels and/or may not feel that they can discuss their stress publicly.

Evidence-informed strategies for the reduction of teacher stress following a disaster have not been identified. However, psychoeducation is a strategy that is highly recommended for all professionals post-disaster (Shaw, Espinel & Schlutz, 2012), is a component of cognitive behaviour therapy, and is acceptable within the context of professional development.

Therefore, the first steps in reducing teacher stress would be the provision of psycho-educational information to the teachers about the effects of stress and how it can impact on them and their pupils. Teachers may believe that the children’s behavioural problems are a result of a breakdown in their teaching competence, or they might blame parents for children’s behaviour, or they might think that children are ‘born naughty’ (Tremblay, 2010). These misunderstandings about the causes of children’s behaviour problems are likely to be affecting their relationships with pupils and parents, and perhaps creating self-blame scenarios. They may be affected by the sources of stress discussed in the previous chapter.

Teachers may also want to discuss strategies for stress that can be implemented at school. For instance, one study of mindfulness with teachers reported that the teachers felt less stressed when using the strategies, although their physiological reactions appeared not to change (Roeser et al., 2013).

Or, teachers may want to consider strategies that they implement privately if they find it more stressful talking about stress with their colleagues. The most successful individual strategies may involve biofeedback; this can be as simple as an app on a smart-phone. Apps can give biofeedback and suggest stress-reducing strategies to help people learn to be aware of and make inroads in controlling their own stress. This strategy is something that the teachers at each school would determine for themselves.

Psychoeducation is the foundational intervention for schools, as the information will also provide the basis for understanding the other strategies. At Step Two, Reaching In-Reaching-Out (RIRO) strategies also directly address teacher stress and burnout by identifying and reducing stressful interactions in which teachers engage, with pupils, colleagues, and parents,

for example (Pearson & Hall, 2017). Thus, during Step One, principals of strategy schools who were implementing strategies were offered training in RIRO methods as a key component of the strategy to improve principals' well-being, and for their evaluation of the suitability of this strategy for teachers during Step Two.

2: Enhancement of the Classroom Environment

The second set of strategies recommended to schools as the first step have to do with the enhancement of the classroom environment to reduce triggers of arousal in stress-sensitive children. These involve establishing a calm-down décor, reducing classroom noise, ensuring optimal light levels during learning times, and consideration of the room temperature. All of these strategies recognise the dysregulation of the autonomic nervous system that is associated with hyper- and hypo- arousal.

Calming Room Decor

The first element of this strategy is 'calm down room décor.' The studies relating to reducing the overall level of decorations in the classroom have been discussed in Chapter 6.

This recommended strategy includes:

- Remove all hanging decorations
- Remove all wall decorations above the child's eye level
- Limited wall displays of instructional aides and child work at child's eye level and below

Hanging decorations might trigger intrusive memories of objects falling from the walls during an earthquake, which 83% of the study children experienced. A slight movement of a hanging decoration in the child's peripheral vision might be a trigger. Wall decorations above the child's eye level may also draw the child's eyes away from an instructional task, and reduce their ability to maintain focus on their learning. Using the wall at eye level and below means that children can find the instructional material they need without craning their necks and perhaps distract other children or themselves from the learning task.

Some wall decorations should be retained (Maxwell & Chmielewski, 2008). This is because children can get used to having the decorations, because classroom decorations can be beneficial to instruction in the long run, and because teachers are invested in – and evaluated

on – the decor of their classrooms. In addition, allowing children to decorate the classrooms with their own work may improve their self-esteem and beliefs about the value of their work, and they also can act as reminder cues, improving their long-term memory of educational information (Imuta & Scarf, 2014).

Figure 8.2. The Ministry of Education's Opoutere School illustrates the 'calm down' room decor approach to wall colour and decorations. Photo credit: https://www.builtsmart.co.nz/about/school-testimonials.

To optimise classroom visual environment, consider the relevance and the novelty of the decorations. This strategy recommends removing the hanging decorations, and the wall decorations above the child's eye level to reduce the overall impact of over-stimulation on arousal levels. As Fisher, Godwin and Seltman (2014) pointed out in regards to the visual environment, "Too much of a good thing may be bad."

In strategy schools, similarly to schools in Australia, USA and the UK, all of the rooms observed had hanging decorations, numerous wall decorations and learning materials posted on virtually every surface.

Wall Colour

The second aspect of the room décor has to do with the colours that the rooms are painted. Some rooms are painted in dark or intense colours, such as dark blue or grey or red or orange. These colour schemes arose from the same idea when it was believed that children needed to

be stimulated to think. At present, children are overstimulated, or unable to process excessive stimuli, or their biology is over-responsive to intense stimuli, so a very stimulating environment can be a trigger or a source of additional stress that children must cope with.

Therefore, changes to the wall colour of classrooms should be considered. Such changes can be trialled by covering the lower parts of the walls with pale blue or pale green paper underneath retained decorations. Any exposed colour from the wall that's not decorated should be a very pale colour. Pale blue and pale green walls have been associated with lower levels of anxiety in several studies. Also, the relationships between decor colour, arousal and performance have been studied, although not necessarily with children, or in a post-disaster situation, as explained in Chapter 6. Thus, changing the room colour is a recommendation for promoting calm classrooms.

Reduce Classroom Noise Levels During Learning

The effect of noise on learning, behaviour, and well-being was discussed in Chapter 6. To reduce noise, a device that displays the noise level and provides non-verbal feedback on the noise using a free application is recommended. This is the Too Noisy Pro App, as partially shown in Figure 8.2. The "Too Noisy" App is displayed on a wall or whiteboard using a data projector or through an iPad, hung, say, on the whiteboard, so that the whole class can see it. It does not rely on the teachers telling the children to be quiet (so avoiding the problem of a language-based intervention).

Figure 8.3. A teacher explaining the Too Noisy App: a video from http://toonoisyapp.com/.

The visual display provides information directly to the class on the noise levels. The app has its impact because the children learn to self-regulate their noise, and also there's some peer pressure to be quiet. There are a number of settings and feedback icons that are controlled by the teacher. The “Too Noisy” Pro App has been evaluated as better than any of the other apps available for noise reduction, but there is no research evidence on it, but plenty of teacher testimonials and reviews.

Table 8.1. Information about Too Noisy Pro App

Content	**Link**
Too Noisy App	http://toonoisyapp.com/ video introduction: https://www.edtechmonster.com/p/too-noisy-free-sales
Richard Byrne’s “Free Technology for Teachers” webpage.	http://www.freetech4teachers.com/2014/04/too-noisy-give-your-students-visual.html#.Wg5ASoZx01g
Edudemic, Connecting Education and Technology	“Too Noisy the Best App to Quieten Your Classroom” http://www.edudemic.com/too-noisy-the-best-app-to-quiet-your-classroom/
Academy Apps	“Classroom Management App for Teachers.” https://www.youtube.com/watch?v=j43TQ2JHszw
Common Sense Education	“Too Noisy Pro” https://www.commonsense.org/education/app/too-noisy-pro
JTRS Limited (UK)	“8 Reasons why Too Noisy Pro is an Essential App for Teachers.” https://www.jtrs.co.uk/blog/teaching-with-technologies-1/post/8-reasons-why-too-noisy-pro-is-an-essential-app-for-teachers-11

It's really important to look at the noise level during a learning because the noise levels affect children's ability to read and collaborate. On the positive side, a study published in 2000 in the *Journal of Environmental Psychology* showed that even a five-decibel drop could make the difference in beginning reading (Maxwell & Evans, 2000). A five-decibel reduction might be achieved over five to eight weeks using the app.

Increase Classroom Light Levels During Learning

As lighting fixtures changes are not achievable within the current level of resources, and adding reading lights to children’s desks would also not be achievable due to installation of power points and health and safety issues (and many innovative classrooms do not have pupil

desks), the opportunities for improving lighting in the classroom were limited. The following strategies were suggested:

- Remove decorations from windows, as these block light entering.
- Keep curtains open during learning times.
- Turn on overhead lights during learning times.
- Seat children with problems in reading, writing or maths near the windows to improve the light levels for learning.

These straight-forward strategies can improve lighting levels.

Room Temperature

The literature search did not identify suggestions that were do-able for moderating room temperature on hot or cold days, as changes involved structural modifications to existing buildings, and were beyond the scope of the project. Teachers could place a thermometer in the classroom, and keep in mind the temperature during learning activities. Classrooms that are too hot (above 28^o) or too cold (below 20^o) are not considered conducive to learning, and teachers could schedule alternative activities during time periods when the classroom temperature was not within the recommended range.

3: Improving Children's Health

The next set of recommendations has to do with instituting changes to improve the child's health and well-being during school. This means becoming aware of the effects of dysregulation on the children's autonomic nervous system, including impacts on diet and hydration, and implementing strategies that assist the child's circadian rhythm.

Play-Eat-Learn

This strategy involved changing the schedule of the school day – reversing the order of eating and playing for morning tea and lunch. In the USA , this strategy is called "Recess Before Lunch" or 'reverse recess.' As New Zealand schools do not use the term 'recess' and refer to "playtime', the phrase "Play-Eat-Learn" was invented in this project to describe this intervention.

The first line of evidence supporting this recommendation is the research identifying the association between post-traumatic stress and health problems, as explained in a previous

chapter. The second line of evidence supporting this strategy involves research on the effects of breakfast on children's attention, memory and cognitive performance at school. The third line of evidence is related to the positive findings of changing the order of meals and playtime in overseas studies.

Autonomic Dysfunction

Playtime is vital to children's development and learning, and having play breaks during the school day can improve children's thinking, appetite and learning. However, physical activity and eating are also body functions of the autonomic nervous system, and, in children with post-traumatic stress symptoms, these functions are highly likely to be dysregulated (Gupta, 2013; Rees, 2014).

One of the findings of the Juniors Study is that the children who have post-traumatic stress symptoms also have parent-reported health problems and eating issues, and this is also prevalent in other studies of children in earthquake-affected communities (Zhang et al., 2015). During the interviews, many teachers noted that children have fatigue and other health problems, headaches and stomachaches. These are markers of the dysregulation of the autonomic nervous system that are associated with post-traumatic stress (Gupta, 2013; Rees, 2014).

The dysregulation of the autonomic nervous system associated with PTSD means that appetite and the processing of food by the body are also affected. Eating disorders, obesity, depression, anxiety and PTSD are all associated with disruption of the appetite aspects of the autonomic nervous system. This disruption affects craving for certain foods and sweet drinks that can reduce autonomic stressors (i.e., "comfort foods") and can result in changes in eating patterns, including loss of appetite or increased appetite (Chrousos, 2009; Van der Kolk, 2004). All of these changes are associated with the impact of PTS on the autonomic nervous system.

Children with poor nutritional status have increased markers of autonomic nervous system dysfunction, including heart rate variability and brain activity (Kim at al., 2017). Many study children had parent-reported difficulties with eating, and also PTS can affect the digestion and processing of nutritional food, thus identifying one potential association with loss of concentration and increases in behaviour problems by mid-morning. One approach to

assisting in the healthy re-regulation of the autonomic nervous system may be to align the activity and eating functions with normal body rhythms (Yoshizaki, et al., 2013).

Breakfast At The Start of The Day

It is estimated that about 87% of school children eat a healthy breakfast before school while 13% of New Zealand children do not (Ministry of Health, 2013) and Kiwi children who skip breakfast are more likely to be obese (Duncan et al., 2008). It may be hypothesised that skipping breakfast further dysregulates the autonomic nervous system, or is an outcome of that dysregulation's impact on appetite.

In New Zealand, two companies, Fonterra (milk) and Sanitarium (cereal), started providing breakfasts to children from schools in high deprivation neighborhoods attending schools in deciles 1-4 through the 'breakfast club' programme, and, in 2013, government funding was provided for this programme (Chapman & Moir, 2013). In the Juniors Study, three schools had breakfast clubs. Breakfast was typically available from 8 or 8:15 to 8:30 am. The timing of breakfast (or not eating breakfast at all) can be associated with the circadian rhythm and the need to eat in mid-morning.

Eating breakfast has long been associated with improved school performance in children, and the provision of breakfast for every child has been an aim of many programmes overseas and in New Zealand. In addition to eating breakfast, the type of food consumed has been the focus of study. Some breakfast foods are identified as producing better impacts on children's attention and learning.

In a meta-analysis of 47 studies involving children, Rampersaud and associates (2005) reported that not only do children who eat breakfast perform better on cognitive and memory tests; they also have fewer school absences. They also have a healthier nutritional status. Surprisingly, children who ate breakfast were *less likely to be overweight* even though they consumed more calories. In adolescents, eating breakfast not only improved cognitive performance, but it also improved mood (Widenhorn-Müller, Hille, Klenk & Weiland, 2008).

A more recent review confirmed that breakfast was associated with better performance on cognitive and memory tests. Although studies of other benefits of breakfast may be confounded by the relative wealth or poverty of the children's families, the findings on

attention, cognition and memory were supported as

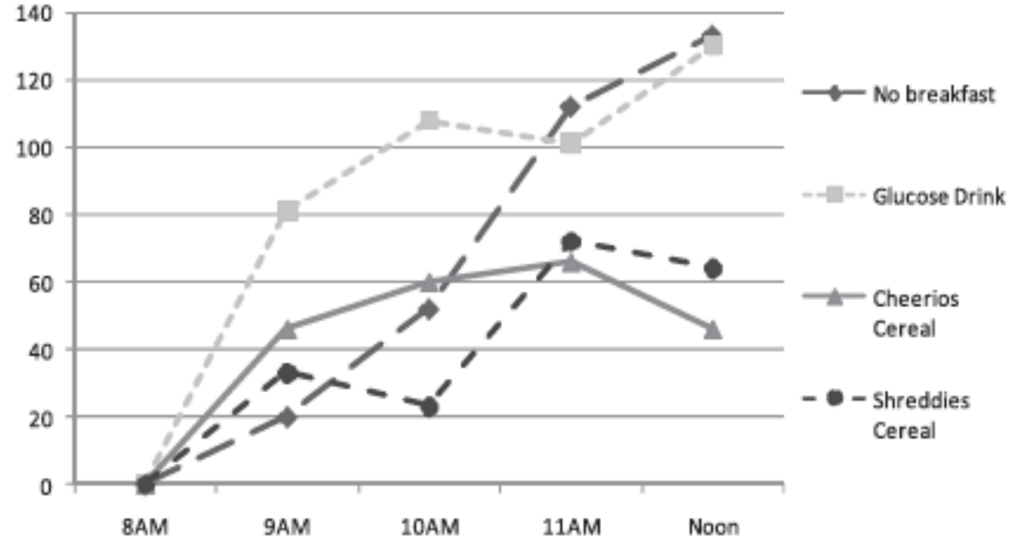


Fig. 1. Deterioration in attention scores (higher score worse) in normal children after different breakfasts at 8:00 AM—Cheerios whole-oat cereal or Shreddies whole-wheat cereal, both consumed with milk. The glucose breakfast had the same number of calories as the cereal breakfasts. Both cereal breakfasts damped the late-morning attention deterioration. (*Data from* Wesnes KA, Pincock C, Richardson D, et al. Breakfast reduces decline in attention and memory over the morning in schoolchildren. Appetite 2003;41(3):329–31.)

Figure 8.3 Graph showing the degradation of children's attention over four school days associated with different breakfast conditions. From Wesnes, Pincock, Richardson, Helm, & Hails (2003).[13]

independent of family income or socioeconomic status (Adolphus et al., 2013). For example, Wesnes and colleagues (2003) measured the deterioration of attention following eating various types of breakfasts, or no breakfast in children and adolescents ranging in age from 9 to 16 years (Figure 8.3). Two of the breakfasts involved cereal and one involved a juice drink. The reduction in 29 children's attention from 8 am, the time they ate breakfast until noon was recorded over four days. The group that ate a breakfast of complex carbohydrates (i.e., Shreddies) was able to maintain their attention levels for the longest duration. A follow-up study replicated the positive effects of breakfast on cognition and memory outside of a laboratory setting in a large sample of children from across the UK (Wesnes, Pincock & Schloey, 2012).

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[13]Under the rules and regulations of the Copyright Clearance Centre, up to 10% of a journal article may be reproduced for 'fair dealings,' including educational purposes, with appropriate attribution of the copyright holders. It is under this provision that this figure has been included here.

In an analysis of the studies regarding the effects of breakfast, children's ability to pay attention had seriously degraded by 120-180 minutes after eating. This was similar to the reports of teachers in the Strategies schools in terms of the time of day at which children's behaviour deteriorated in the morning (following breakfast and arrival at school) and in the afternoon, following lunch.

Breakfast Time and Attention In the Classroom

If children eat breakfast at 8 am, then they would be able to pay attention until around 10:15. Traditionally, this was approximately the time of day that schools scheduled 'morning tea', and that would fit in with the research on breakfast and attention discussed above. Many teachers identified that this was the best time of day for learning (e.g., before morning tea time), and the time of day when there would be few behaviour problems. Not surprisingly, this was the time of day that teachers were the most likely to focus on teaching reading.

However, the interviews with teachers identified that many children began showing up on the school grounds around 8 am, which fits in with a routine of parents of dropping off children at school before going to work. Logically, then, if children are arriving at school at 8 am, they are eating breakfast by around 7:30 am. This means that their attention will begin to degrade by 9:30. Children who are not eating breakfast at home and are not in breakfast club and children who are eating an early breakfast will have great difficulty concentrating on learning by 9:30 am, as the previous research indicates their attention will have declined by 40% compared to what it was at 8 am.

Some teachers identified attention problems in small groups of children beginning during this part of the school day in the interviews conducted in Strategy schools. It may be that these children who ate early in the morning, or are those that missed breakfast. However, not eating breakfast may not be due to parental neglect, as is often inferred, because stressed children may have reduced appetites and not be interested in food (Carmassi, Bertelloni, Massimetti, Miniati, Stratta, Rossi, & Dell, 2015). In that case, parents will not be able to force their child to eat breakfast. If some children's attention starts to flag around 9:30 am, other children in the classroom are also likely to be distracted from learning.

Morning Tea Time

If school children have a Kiwi morning tea at 10:30, their attention may be improved, but this will degrade more quickly than breakfast, unless what they eat is substantially similar to breakfast. Therefore, if the mid-morning 'tea' snack is not nutritionally as beneficial as

breakfast in maintaining attention, the effects of improved attention are likely to last for about an hour after the end of morning tea. After that time, children's behaviour would become less regulated. This is exactly what most teachers described during the interviews. As play follows morning tea in most schools, 20-30 minutes of this time of high attention after eating morning 'tea' would be spent out on the play field instead of in academic learning. If the children engaged in active play during play time, this would likely contribute to feeling tired and out of sorts by about 11:30, as the effects of the food at morning tea wore off more quickly due to the play time effect.

Lunch Time

In the study schools, lunch was typically scheduled to begin around 12:15 to 12:45, although it differed from school to school. Assuming that children ate a reasonably healthy lunch (!), they would again experience a degrading of their ability to pay attention by around 2:15 or 2:30. As the majority of teachers identified during the interviews, this time of day was the most challenging for children's behaviour and the least likely to produce benefits in terms of children's learning.

"Comfort" Food

It is common for adults to eat 'comfort foods' when stressed, and this is associated with autonomic dysfunction. Therefore, it is not surprising to find that children also want to have 'comfort food' in their lunch boxes and for morning tea. Consider how an adult might feel if they were told they could never have a drink of alcohol or a bar of chocolate! Before taking away 'comfort food' from children, the overall health of the child's autonomic nervous system be considered (Carmassi, Bertelloni, Massimetti, Miniati, Stratta, Rossi, & Dell, 2015). A logical analysis highlights the issue: taking away food is associated with punishment, and punishment is likely to increase the child's stress responses and also increase their desire to eat the food due to the increased dysregulation of their autonomic nervous system caused by the fear response. A consideration of stress, food and obesity is included in Appendix 3.

Summary of Evidence on Current School Day Schedule and Children's Learning and Behaviour

Overall, the research evidence on children's attentional abilities following breakfast and lunch is supported by teacher observations. The number of children with post-traumatic stress symptoms indicated autonomic nervous system dysfunction, which can affect appetite and attention. Research also confirmed teacher reports that the degrading of children's attention is tied to the circadian rhythm of children's scheduled eating times. Children's attention flagged during long periods between eating. An analysis of the school day schedules in the Strategy classrooms indicates that the schedule of the school day and that physical activity followed eating, could be contributing to the behaviour problems of the study children.

Evidence on Changing the Schedule of the School Day: "Recess First"

Changing the order of recess or playtime and lunch has been shown in overseas studies to improve children's ability to pay attention in classrooms. In the 'play first' condition (i.e., recess first), the children eat more, drink more milk, drink more liquids, and have improved readiness to learn according to their teachers (Hunsberger, McGinnis, Smith, Beamer, & O'Malley, 2014). This may be because the children are not rushing their lunch to get out to the play fields to meet up with friends or to claim a particularly desirable piece of play equipment or similar reason, so they eat more food, eat more slowly, have time to calm down, and so forth. The improved attention is due to having the learning immediately follow eating, which is the period most associated with attention, cognition and memory.

An evaluation of the programme in Montana (Bark et al., 2010) found that moving playtime before lunch resulted in many benefits, including more food being eaten, a calmer lunchroom atmosphere, and a dramatic decrease in disciplinary problems. Hunsberger and colleagues (2014) reported that primary school children aged 6 to 10 who had 'recess first' consumed more fluids, and their teachers reported better classroom behaviour and readiness to learn in the afternoon as compared to a randomly selected control group who had the standard schedule.

As scheduling playtime before lunch has such a solid evidence-base of benefits, a number of health researchers were curious as to why schools were not taking up this strategy. Price and Just (2015), professors at the University of Utah and Cornell University in the USA published

a study in *Preventative Medicine* taking up this question. They write, "*Previous studies have documented administrator, teacher, and parent concerns surrounding this change in schedules. Popular concerns are logistics of supervision, hand-washing, cold weather clothing, tradition, scheduling, exercise, communication, nutrition beliefs, academic or curriculum priorities, and resistance by the staff*".

In a study conducted in Hawaii by Tanaka and colleagues (2005), some primary teachers and administrators were sceptical before the implementation of the playtime before lunch programme, and held the beliefs reported by Price and Just. However, after experiencing the benefits, they changed their minds and reported highly positive experiences.

Based on the evidence to date, even though changing the order of playtime and morning tea, and playtime and lunch might seem very difficult to conceptualise as having a positive effect, this change is recommended (e.g., Figure 8.4). In some instances, it may be advisable to add a snack to the schedule in order to create sufficient opportunities to eat at biologically necessary times. This possibility is considered in the next strategy.

Alongside Play-Eat-Learn, scheduling instruction in crucial academic skills, such as reading, writing and maths, during the early part of the "Learn" schedule is likely to maximise the effects. Estimating a time to see the effects of change is difficult, but one of the studies found an effect within three weeks. However, that study was not conducted in a disaster-affected community, nor did the children have high levels of arousal, so this might take maybe twice as long, possibly up to a school term of ten weeks.

Time of Day	Location	Activity	P E L
7-8:55	Before School Routine	Home	Play, Eat
8.55-9:20	School begins	Karakia, Hui	Learn
9.20-9.30	In class	Morning snack (Milk and complex carbs)	Eat
9.30-11:00	In class	Reading and Writing	Learn
11am-11.15	Outside	Morning play time	Play
11.15-11.25	In class	Morning tea *Child's own food	Eat
11.25-12.45	In class	Maths	Learn
12.45-1.15	Outside	Lunch play time	Play
1.15-1.30	In class	Lunch *Child's own food	Eat
1.30-2.45	In class	Maths/Topic/Art etc.	Learn

Figure 8.4. An initial Play-Eat-Learn schedule at one of the strategy schools.

Drink to Think-Think to Drink Programme

Research has shown that children are often dehydrated, and dehydration can affect the growth of their brain, as well as negatively affect their thinking during the school day (Bar-David, Urkin & Kozminsky, 2005; Kempton et al., 2011; Kenney, Long, Cradock, & Gortmaker, 2015). Many children are likely to be dehydrated following play and lunch, and dehydration can contribute to poor concentration, memory and increase impulsive behaviour. Water can be drunk with lunch, but children might still be de-hydrated after lunch, as children's needs for water are different to adults [see box].

More than half of children may be dehydrated at school, and boys and children from minority ethnicity were the groups most likely to be dehydrated in a national study from the United States (Kenney et al., 2015). Symptoms of mild dehydration can be difficult for teachers to pick up, and often these symptoms are interpreted as 'bad behaviour'. In class, dehydrated children may become cranky, tired and distracted. By the time they get home, many dehydrated children are complaining of tiredness or headaches and some may be too lethargic to do anything but crash in front of a screen. Although this behaviour may be considered 'normal', it is now known that it may, at least in part, be due to the effects of dehydration.

> "Adequate fluid intake is critical for survival. While adults are at liberty to drink fluids as wanted, children and infants are dependent upon caregivers for food and fluid. Children are at greater risk for dehydration than adults due to their higher surface-to-mass ratio. Additionally, children have different thirst sensitivities and body cooling mechanisms than adults. Children differ from adults in total body water content, and boys and girls differ in body water content with maturation. Research in young adults shows that mild dehydration corresponding to only 1% to 2% of body weight loss can lead to significant impairment in cognitive function. Dehydration in infants is associated with confusion, irritability, and lethargy; in children, it may produce decrements in cognitive performance."
>
> *- From Hydration and Cognitive Function in Children by D'Anci, Constant and Rosenberg (2006)*

Dehydration may result from inadequate water intake and/or from losing body water and can develop rapidly or slowly. The brain is comprised of up to 73% water (Department of the Interior, 2016) and water is required to think (Gowin, 2010). Research has shown that PTSD can also affect dehydration (Turnbull, 2006).

When children are dehydrated, their cognitive function can be impaired. Giving children water to drink can actually make an immediate and dramatic impact on their cognitive ability. A study by Fuchs and colleagues (2016) classified ten-year-old children into two groups, "low fluid intake" and "high fluid intake" based on the amount of fluid they had consumed in the previous 24 hours. They then gave the children's performance tests of cognition and memory. The children with the high fluid intake outperformed the low fluid intake group, as shown in Figure 8.5, reproduced below. The children who had consumed fluid shortly before the tests also did better than children who had consumed fluids earlier in the day. This is one of many studies that demonstrated the importance of adequate and continuous hydration for learning.

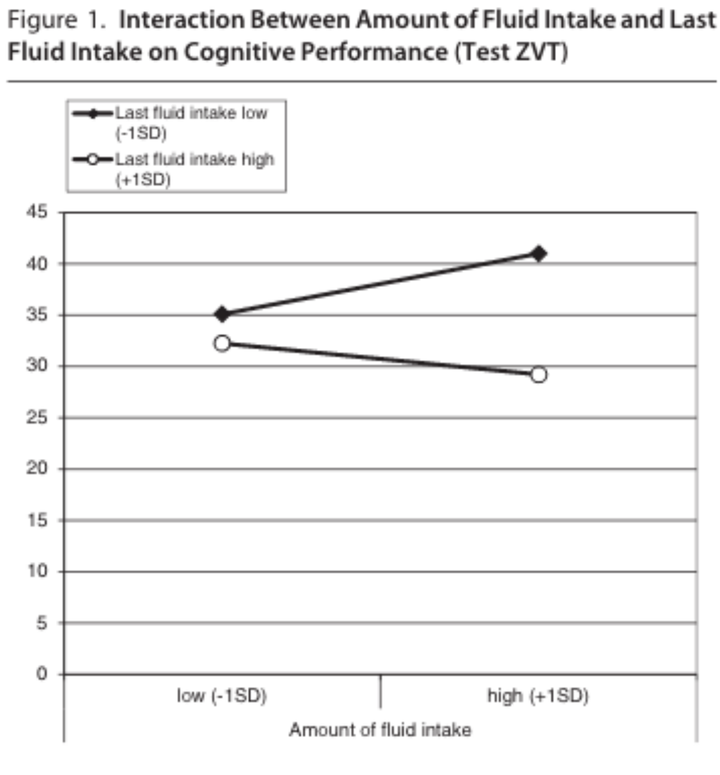

Figure 8.5. Children with high water intake performed much better on tests of cognition and memory (from Fuchs et al., 2016).

Fadda and colleagues (2012) conducted an intervention study on the effects of giving a group of children water before they tested them on cognition and asked them how they felt.

Children's hydration was measured by urine testing at the start of the school day, and their cognition and mood were tested (pre-test). Next, children were randomly assigned to the hydration intervention group or the control group. When the intervention group was given access to 625 ml of water, 19 children drank all of the water and 2 children did not drink any water. The children's hydration status and cognitive and mood tests were repeated (post-test). The results showed that the intervention group out-performed the control group on the cognitive and memory tests, and the children reported feeling better and having more energy, feeling less tired, and better able to concentrate (Fadda et al., 2012). Other studies have shown that the benefits are not the same when sweetened drinks or juice are consumed instead of water.

A study of teachers' knowledge about the effects of hydration indicated that they were not aware of how dehydration affects children's concentration and learning (Johnson et al., 2008). The study also found that teachers were also dehydrated. This dehydration would have had a negative effect on the teachers' ability to teach and their mood as well! Even people who are aware of the effects of hydration often forget to drink water.

In Strategy Schools, some children had water bottles provided by their parents, which were not easily accessible in their classrooms during academic learning periods. Most children drank water from water fountains during play. Unfortunately, bullying and aggressive behaviour were observed around fountains, which would discourage children from using fountains. In addition, children with PTS do not receive timely 'signals' from their body to drink water, due to the dysregulation of their autonomic nervous system.

Hydration is simply having enough water in your body. The standard recommendation for children is 5 glasses (1 litre) for 5 to 8-year-olds, 7 glasses (1.5 litres) for 9 to12-year-olds, and 8 to 10 glasses (2 litres) for 13+ years (Gibson-Moore, 2013; Ministry of Health, 2015).

Therefore, the recommended strategy is a health education programme, "Drink to Think, Think to Drink." (McClelland, Ismail, Liberty & Hooper, 2016). This programme includes the components described below.

Teacher Professional Development, which involves a short session about the importance of hydration to children's attention, thinking and mood. The procedures for children's use of water bottles in the classroom use are explained. Teachers receive drink bottles for their use in modelling good hydration. Teachers also are given materials to use with curriculum components with the children.

<u>Parent Information</u> about the *Drink to Think* programme is sent to parents and families with guidelines on children's fluid consumption at home.

<u>Pupil Education About Drinking Water</u>. The children receive information in a school assembly on the importance of water to their health and are given suggestions about why and when to drink water, and about how much water to drink each day, and how to self-monitor drinking. The relationship between feeling stressed, worried, tired, and so forth is explained to the child.

<u>Transparent Water Bottle for In-Class Use.</u> Each pupil receives a drink bottle during the information session (Figure 8.6). The bottle is introduced as a gift to help the children learn to look after themselves.

The drink bottles recommended for the children were made in New Zealand by Sistema Water systems (Figure 8.6). They are BPA free and transparent so that the children and teachers can monitor fluid intake. The water bottles are kept in the classroom, and children are given instructions as to how much to drink during the information session. The bottles may only be used for water. Schools develop procedures for ensuring that the bottles are cleaned.

Figure 8.6. Sistema water bottles used in the Drink to Think-Think to Drink programme. Photo credit: Kathleen Liberty

The Drink to Think-Think to Drink programme is recommended as a strategy to improve the health of the children (and teachers) by a combination of psychoeducation and having water conveniently close by in the classroom while children are learning. Learning the importance of water to health, its relationship to stress and the skills to monitor their drinking times and volumes are very important skills in developing resilience to stress. This is a life-course stress-related strategy, and “Drink to Think” is the first coping strategy that is taught to the child in the Strategies Project.

Wholemeal+ Snack

One of the aspects considered in the evidence for Play-Eat-Learn in the previous chapter was the importance of a healthy breakfast. In subsequent studies, the nutritional compositions of the most beneficial breakfasts were studied (Ingwersen, Defeyter, Kennedy, Wesnes & Scholey, 2007) and breakfasts with complex carbohydrates were identified as an important component in maintaining attention. In the Micha et al. study (2011), the breakfast associated with the highest levels of cognitive function and attention in children in school years 7, 8 and 9 was described. “The recommended meal of low-GI high-GL breakfast in this study consisted of 66g of Alpen muesli (no sugar added in the muesli mix) with 7 g of white sugar sprinkled on the top, 200 ml of trim milk, and 245 ml of apple juice. This includes approximately 36 g of complex carbohydrates.”

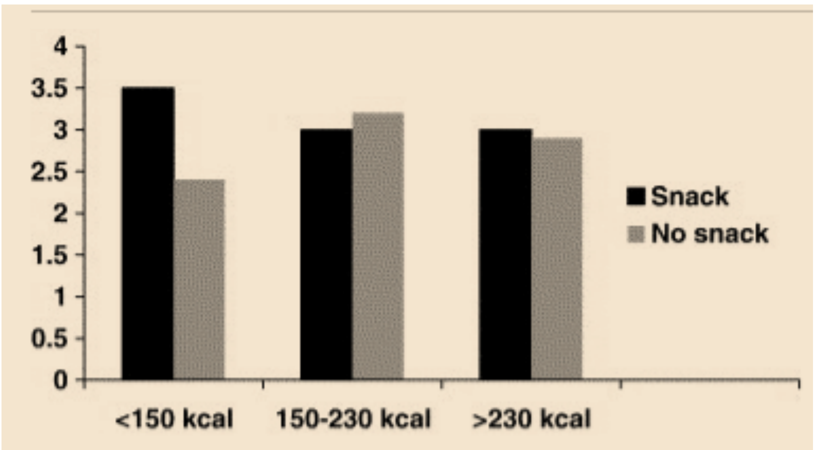

Figure 8.7. The effect of a snack (vs no snack) on children’s attention in the classroom was dependent on the calorie-load of their breakfast as shown by Benton and Jarvis (2007).[14]

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However, as in the USA, many children do not eat breakfast, or may eat a breakfast that is high in sugar, research into improving children's health, and academic achievement has studied the effect of a mid-morning snack on children's learning. Benton and (Jarvis, 2007) studied the effect of a mid-morning snack on children's school performance depending on the engery qualities of their breakfast. The snack in this study was a muesli bar provided free by Kellogg Corporation: nutritional information given for each bar: 35 g carbohydrates, 2.5 g protein and 1 g of fat.

Figure 8.7 illustrates that children who had a low-calorie breakfast, or no breakfast at all (the left-hand bars) had better attention to a task after the snack at mid-morning as compared to children who did not have a snack. Similarly, children who had a higher- calorie breakfast (the right-hand bars) had somewhat better attention after a snack. Only children whose breakfast fell into the recommended calorie range (middle bars) showed no positive effect of a mid-morning snack on attention.

A study of older adolescents and young adults found that the combination of breakfast and a mid-morning snack produced benefits in attention and improved mood, including feeling happy, sociable, and less anxious (Smith & Wilds, 2009). In that study, the snack consisted of: "participants' choice of Kellogg's Nutrigrain bars: Apple, Blueberry, Fruit/yoghurt or Strawberry; or Kellogg's Elevenses. Each bar provided 555/133 KJ/kcal, 25.5 g carbohydrates, 1.5 g protein, 2.96 g fat and between 0.75 and 1.11 g fibre."

These studies provide evidence that adding a high carbohydrate snack to the school day has potential benefits, particularly for children who do not eat breakfast, and for those with PTS symptoms whose digestion of foods may be affected.

Usual Morning Tea is Not Sufficient

In the Strategy Schools, children eat a 'morning tea'. This is usually part of their lunch sent from home, but in some schools, a piece of fruit and UHT milk are available (Fonterra, 2017; Ministry of Health, 2017b). Evidence from teacher interviews as to the timing of children's behaviour problems and the general reduction in learning efficiency between 11-12 am, following morning tea, indicates that the nutrition from morning tea is not sufficient to maintain attention throughout the morning. This information, considered alongside the research on the impacts of PTS on children's autonomic nervous system, led to

recommendations to change the schedule for eating, to introduce a high carbohydrate snack, and to increase water consumption.

Wholemeal Snack

A mid-morning snack that approaches the composition of the snacks used in the research studies, and which is affordable in schools is a slice of wholemeal bread or a wholemeal roll. A mid-morning snack of one slice of wholemeal bread will have approximately 28 g of complex carbohydrates, which is in the range of the snacks in the studies that improved cognition and attention. Adding a spread increases the nutritional value, as explained in the next section. It is recommended that the wholemeal snack + spread be offered to children at the mid-morning "Eat" time-period within in the Play-Eat-Learn schedule (Figure 8.4).

Fruit does not have the same impact on attention as does a complex-carbohydrate snack, so it is recommended that fruit, if available through the fruit-in-schools-programme, or in the food provided by parents, be consumed at lunch or in the afternoon snack, or, with the wholemeal snack at mid-morning.

For children who are gluten intolerant, 35 g of air-popped popcorn is a suitable alternative. Popcorn is available in snack-sized packets in most grocery stores.

Suitable wholemeal bread in New Zealand must be identified from the ingredients list: suitable bread will list whole grain or wholemeal as the first ingredient. Multigrain, 5-grain or 7-grain breads don't always mean they use whole grain or wholemeal, so the label is not a reliable indicator.

Next, the ingredient list should identify the grams of fibre in each slice: it is recommended that each slice have 2g or more of fibre. In considering ingredients to determine a suitable snack, note that inulin and polydextrose are two additives used to artificially boost fibre, and bread with these ingredients may not otherwise meet the required fibre per slice recommendation.

As an example, consider the ingredients listed for two different bread loaves in Figure 8.8. The ingredients of the loaf on the left indicate it can be considered a suitable complex carbohydrate for a snack because (a) it includes whole grain wholemeal, it includes more than 2 g of fibre, and it does not include added fibre. However, the wholemeal loaf on the left is less than half of the recommended complex carbohydrates of the snacks in the study per slice, so two slices would be needed to be the almost equivalent to the study snacks. Unfortunately,

the 'wheatmeal' loaf on the right does not actually include any "wholemeal." Therefore, it is not suitable no matter how many slices are consumed.

YES	NO
• **Tip Top Super Soft Toast Bread Wholemeal 700g** • Wholegrain Wholemeal Wheat Flour (49%), Water, Wheat Flour, Bakers Yeast, Wheat Gluten, Iodised Salt, Canola Oil , Acidity Regulator (263), Soy Flour, Emulsifiers (481, 472e). 2.25 fibre/slice, 15.5 cc	**Wheatmeal 600g** Wheat Flour, Water, Wheat Bran (6%), Yeast, Iodised Salt, Canola Oil , Soy Flour, Emulsifiers (471, 481), Acidity Regulator (263)

Figure 8.8. The ingredients for two different bread loaf products available locally.

Wholemeal Snack Plus Spread

The slice of wholemeal bread can be spread with: Marmite, Vegemite, Peanut Butter, Butter, or served plain. These spreads can also contribute to a healthy snack that can benefit children with stress-sensitive autonomic nervous systems.

Marmite and Vegemite. Although the ingredients are a trade secret, both are made from yeast extract. Yeast extract contains B Vitamins and Folic Acid (which are associated with stress reduction, improved immune function and healthy brain function for cognition and short-term memory). Marmite and Vegemite also are a source of vegetarian protein (vegetarian) and are gluten-free.

Butter. Butter contains Vitamin K2, which improves gut bacteria, immune function, and metabolism, which would be very useful to children with a dysregulated autonomic nervous system. Butter is a source of omega 3, which is associated with brain health and improved behaviour in some children (see next section). Butter also has protein from dairy, some complex carbohydrates and fibre.

Margarine is not recommended, as it does not have the benefits of butter, and it usually has transfats that can be associated with poor health. Jam and jelly are also not recommended, due to their high sugar content.

Relationship to Obesity

It is also important to understand that offering a complex carbohydrate snack is very unlikely to contribute to obesity (see box).

A parent asks: Won't this snack contribute to obesity and overweight?

Kathleen Liberty answers: It's true that people eat when they are stressed. Their body is dysregulated and sends signals, perhaps of the wrong kind. The signal to eat doesn't come with instructions about WHAT to eat! And yes, people do eat sugary and 'fatty' foods that do give a very short-lived feeling of things being better, and this may contribute to obesity (Obesity is a stress-related disorder of the autonomic nervous system). However, eating only the food we recommend in our strategy (1 slice wholemeal bread with peanut butter, butter, or marmite/vegemite at a specific time in the morning) will not contribute to weight gain, and will help suppress the urge to snack on unhealthy things. If information about eating and learning is included in a science education programme, the children will learn the type of food that really helps their body and that the sugary fatty foods will actually not help them. Telling them not to eat at all when their ANS is sending them signals about hunger just creates more stress and exacerbates the dysregulation. This may make them hide when/what they eat and feel shame and helplessness, and these emotions are further stressors of the ANS. Denying people food when their ANS is dysregulated is not a well-being strategy in my opinion. The timing of the snack is designed to help organise the ANS along with the other changes to the daily schedule.

I absolutely agree that it is important to teach children healthy habits. However, children are not able to learn/remember and then implement strategies when their ANS is dysregulated. The data indicate a majority of study children in your school have disrupted sleep and other indicators of ANS dysfunction. Your school also has children with eating difficulties! The review indicates we can presume that the biological bases of their memories, inhibition, executive function and motor planning are disrupted due to the dysregulation of the ANS. This is why trying to teach them healthy habits via verbal instructions, posters or verbal reminders are not working.

If every child were taking Smart Bites, this would help even more, as the omega 3 facilitates the myelination of the neurons (now being stripped of myelin by the effects of stress). There is a little bit of omega 3 in peanut butter and butter. If we could get rid of the UHT milk and bring back blue top (which has omega 3) that would help. Preschool children who drank whole milk were less likely to be obese as compared to obese children who drank trim milk in a recent study.

> However, the other point that I wanted to make is that, if the sleep education programme is successful, and the children come to school next year with better sleep hygiene and they are able to maintain this with support from the sleep follow-up unit in Term 1 2018, then there may not be a need for the wholemeal snack next year. That is, once the children start sleeping, and the arousal levels and behaviour problems in the classrooms are reduced, their ANS should be in a lot better shape! At least, that is our current hypothesis.
>
> Hope this helps give some additional perspectives

Research sources for this section are included in Appendix 3.

Step One Strategies for Parents

Information for Parents About Stressed Children

The first strategy recommended for parents is psychological education as to the effects of stress and disasters on children's development, and the reasons underpinning the strategies that schools adopt. In the Junior's Study, this information was provided to study parents using letters. This strategy was not clearly considered within the original Strategy Plans, as so much information had already been provided to parents. However, recently, study school principals and principals in other schools considering the strategies have pointed out the need for such material. This is confirmed by numerous studies and is a key component of therapy for children, parent training programmes, and community intervention projects.

The provision of psychoeducation through schools has shown promise for parents of children with emotional or behavioural disorders, and in understanding PTSD (Lukens & McFarlane, 2004; Pollio et al., 2005).

Psychoeducation is also a positive focus, rather than a deficit focus, and emphasises understanding and prevention, rather than labelling and blame, and fits within the inclusive society that New Zealand is building.

The chapter in this book about how children cope with stress, and the appendix on emotion coping, may be used as part of a psychoeducation programme. This material covers children's behaviour when they are stressed, why children behave this way, how children cope with stress, how to help children calm down and how to help children learn self-regulation.

A parent version of the Reach In Reach Out programme is also being developed for the step 2 strategies by Maureen Allan of the Te Paeroa RTLB Cluster and a trainer in the RIRO programme.

Psychoeducation of parents and teachers is of utmost importance in enduring that parents and their child's teacher are "on the same page" when it comes to supporting children's positive behavioural development. It is also crucial to develop the culture of "no-blame" in the context of understanding children's behavioural stress symptoms. It is not the parents or the teachers who are causing the problems.

Finally, understanding the theory of dysregulation/ re-regulation underpinning the strategies can give parents hope that their children's problems, which have lasted so long, need not be permanent. This attribution is also inherent in the second strategy recommended for some parents.

The second recommended strategy is a diet supplementation for selected study children. Omega 3 is a diet supplementation to reduce behaviour problems associated with arousal and sleep problems. Overall, only about 20% of the New Zealand population is meeting the minimum recommended levels of Omega 3 (Harika, Eilander, Alssema, Osendarp & Zock, 2013).

Diet supplementation can be a contentious issue, and the decision to recommend diet supplementation for very stressed children is not one to be taken lightly. There is an extensive evidence-base for Omega 3, in particular for children with Attention Deficit Hyperactivity Disorder. This evidence is useful because the main symptoms of ADHD, inattention and restlessness, are also associated with PTSD. Because of the extensive data, and because recommending a diet supplementation may be considered unusual in New Zealand schools, there is an extended review provided in Appendix 2 to this book, and a short review in the next section.

Biological psychiatric research indicates that stress during sensitive periods of development, such as the years from 0 to 4 years, may affect the myelination of neurons (Schuchardt, Huss, Stauss-Grabo & Hahn, 2010).

Stressed neurons and dysregulation of the autonomic nervous system can cause the types of stress-related behaviours and health problems reported in the study children (Hibbeln, Ferguson, & Blasbalg, 2006). Lack of Omega 3 is associated with poor health and high

behaviour problems including aggression, especially in boys Stevens, Zentall, Abate, Kuczek, & Burges, 1996).

Good neuron connectivity is vital for emotional regulation. If the children do not have good brain health, this can be an important reason they are having behaviour and body stress problems (Klengel, Pape, Binder, & Mehta, 2014).

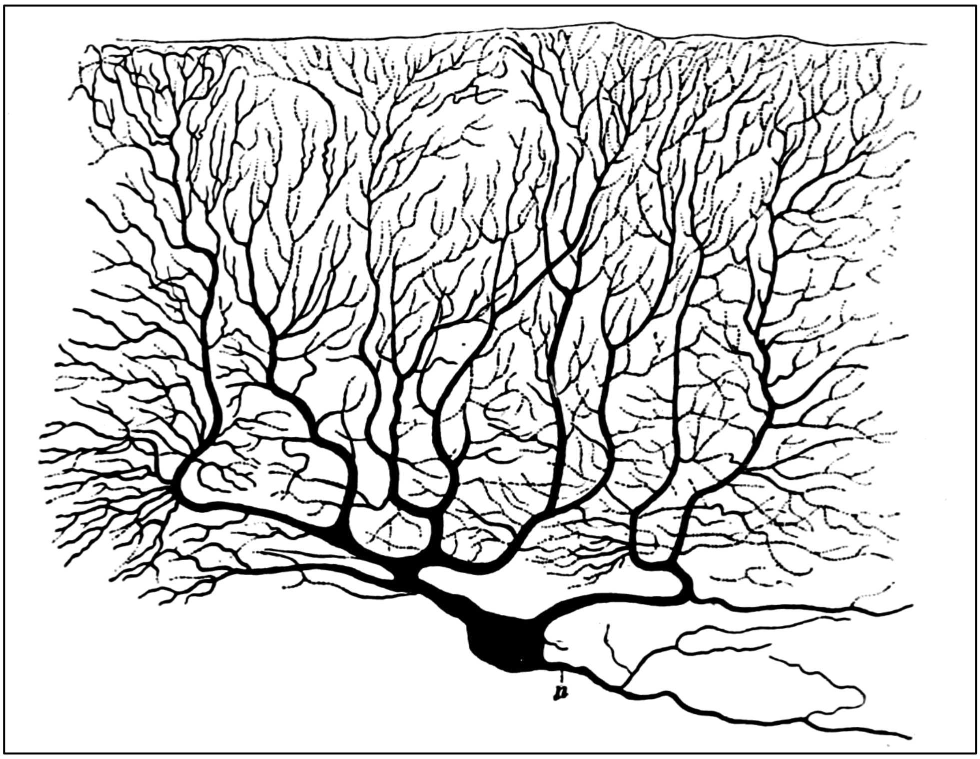


Figure 8.9 Nerve cell from a human cerebellum (Minot, 1907).

Even children eating a healthy diet may benefit from diet supplementation because their body stress may be affecting their digestion. This is because the presence of stressed neurons with little or only thin myelin sheaths and dysregulation of the autonomic nervous system are very likely to reduce the body's ability to make use of the good healthy diets provided by parents, as the autonomic nervous system affects digestion. An addition to the diet is recommended to help aid hneuron health and benefit the health of the autonomic nervous system (a summary of the scientific evidence is included in this book in Appendix 2). [Two-minute neuroscience explanation on YouTube about myelin can be found at https://youtu.be/5V7RZwDpmXE]

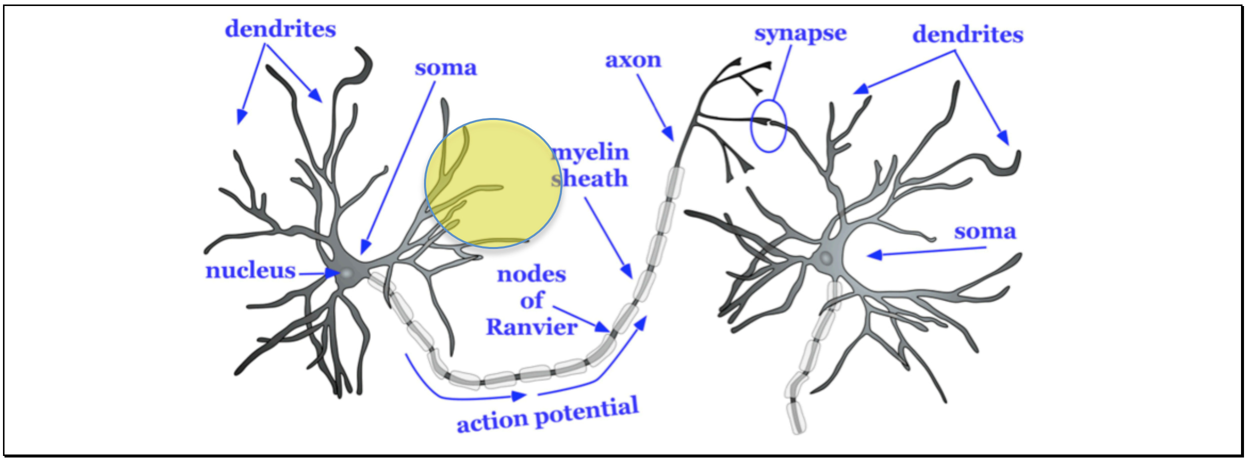


Figure 8.10. Graphic illustration showing myelin. From: Furtak, S. Neurons. Noba project. http://nobaproject.com/modules/neurons, used under Creative Commons Attribution-Non-commercial-ShareAlike 4.0 International License

About 30% of the brain may be composed of omega 3-type fatty acids, (which also contain water). That is why not having enough fatty acids can be associated with poor brain health.

Research indicates that, on average, New Zealand children are likely to have low levels of omega 3-fatty acids (Harika et al., 2013). This is an additional important indicator that highly stressed children can benefit from Omega 3 diet supplementation, as even healthy children in New Zealand have low levels.

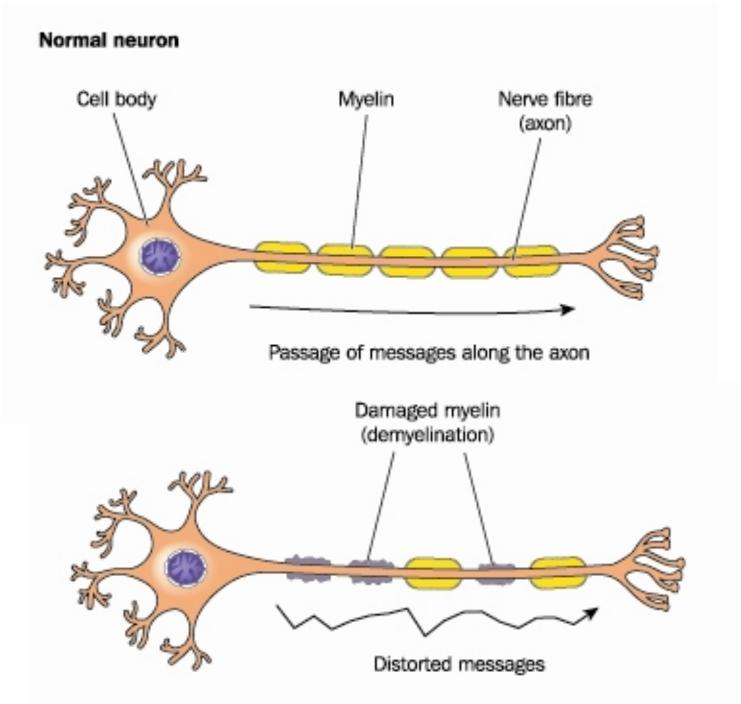


Figure 8.11 Illustration of effects of demyelination (above) or disrupted myelination (below) on signalling (CC BY-SA 3.0 via Wikimedia Commons).

A recent meta-analysis of 73 studies added to the evidence-base that adding Omega 3 to the diet could make significant reductions to aggressive behaviour in children (Gajos & Beaver, 2016). Recommending Omega 3 diet supplementation can help children understand that the problems are not ‘who they are’. It can also help reinforce the idea that these problems come from a dysregulation of body systems due to stress. This can help change the thinking of those parents and teachers who believe the cause of the problems are due to ‘naughty children.” Helping these parents and teachers understand the actual cause of children’s behaviour can improve empathy and reduce tension when parents/teachers attribute behaviour problems to “on purpose” responses instead of the accurate attribution of brain systems dysregulation.

In one blinded randomised controlled research trial of Omega-3, parents of both the Omega-3 group and the placebo group were told that the [juice] would improve behaviour. During the initial six-month period, parent-reported behaviour problems did improve in both groups, and parenting problems reduced. This result may be interpreted as showing that parenting behaviours change if they think the problem behaviour is about some issue related to their child’s brain health. However, once the trial ended, only the children who actually received the Omega-3 juice showed improved behaviour (Raine, Portnoy, Liu, Mahoomed, & Hibbeln, 2015; abstract in Appendix 2).

One potential reason that Omega 3 might improve self-regulation is by increasing sleep. During sleep the brain builds myelin, so omega 3 might affect myelination by increasing sleep duration. In a large randomised control trial in the UK (Richardson, 2015), researchers studied 362 children aged 7-9 years to understand the relationship between sleep and Omega 3. Children who had poor sleep quality had much lower quantities of omega 3-related components in their bloodstream, as compared to children who did not have poor sleep.

In a second study, the research reported that a daily supplementation of 600mg of omega 3 DHA from algae over a 16-week period resulted in an increase in one hour of objectively measured sleep. Parents also reported the quality of their child’s sleep improved, as compared to a group of children who received a placebo (sunflower oil capsules).

According to research, diet supplementation with Omega 3 may assist in improving the health of neurons. This appears to increase the speed, strength and health of neuron connectivity, which may be the potential biological pathway leading to improved behaviour, reduced sleep problems and improved brain health.

Omega-3 is culturally acceptable to Māori families as fish and other kinds of seafoods were predominant in Māori diets, and important to overall well-being/ Te Whare Tapa Wha. Maori traditionally ate Toheroa (paphies ventricosa), which is high in Omega-3, and many other seafoods as a staple of their customary diet, but dietary changes in the 20th century, and the apparent collapse of some seafood habitats seem to have reduced fish and shellfish consumption and may have resulted in Omega-3 deficiencies (Dallman, 2010; Reis, & Hibbeln, 2006).

The recommendation is to provide information to the principal, and the principal determines the best way to invite parents who are interested to receive free bottles of NutraLife Smart Bites, courtesy of the UC Foundation and the Rata Foundation. The project has also provided in Figures 8.13 and 8.14. Since this is a commercially available product, the parents may also decide to provide the supplement privately.

NutraLife Smart Bites are chewable capsules shaped like a fish, and when the child chews them there's a burst of fruit flavoured liquid. Children can eat the capsule coating, or, if children do not like that, they can spit out the capsule. They also can twist and squirt the flavoured liquid into their mouth, or it can be put in juice or milk.

The Strategies Project posted the announcement below to study parents, and schools used a version of this in their newsletter.

If you think your son/daughter could benefit from a diet supplement, the Principal at your child's school has some free bottles of Smart Bites and also has some samples that you can take home and trial. The Smart Bites must be taken every day for 6 months to begin, and up to 24 months for some children. They are good tasting capsules that can be mixed with juice or will dissolve in the child's mouth after they are chewed. The capsule can then either be chewed and swallowed or disposed of. (The fish shapes are not pills). Please contact your child's Principal for more information.

Figure 8.12. NutraLife Smart Bites in 2016.

If a parent took up the offer, the information sheets on the next two pages were given to the parent/caregiver and their child so that they understood the reasons for taking the omega 3 (Figures 8.13 and 8.14). One school also used a star chart that was brought to the Principal on a weekly basis to further encourage the children to take the Omega 3. Information given to children about Omega 3 Smart Bites is shown in Figure 8.14. Of course, children cannot be forced to take Omega 3, and forcing them is likely to, add to their stress. Therefore, information was developed to help children understand the purpose of the Omega 3. This information is really helpful for children. Parents are asked to discuss this information with their child, but the principal may also wish to do so.

The idea of dietary supplementation is often more acceptable to parents rather than feeling like they are to blame for the child's behaviour, which is sometimes part of a hesitation to take up parent training programmes. The estimated cost for the omega-3 is less than 50 cents per day, and it is estimated to take six months for effects to be noticable. Of course, parents would need to be very consistent in seeing that the child took the burstules every day.

Summary of Step One Strategies

The three central recommendations include:

1. Improving teacher, principal and child well-being through information and changes to the classroom environment;
2. Improving child health through changes to the schedule for playing and eating and increasing intake of complex carbohydrates and hydration.
3. Improving family and child well-being for children with the highest need through information and recommendation for diet supplementation.

The recommendations present an integrated, innovative and evidence-informed approach to creating calm classrooms and improving child health and well-being.

The quality and acceptability of the strategies were determined by the school community. The adoption and impact of the Step One strategies are discussed in Chapter 9.

Strategies for Juniors Settling into School and Learning

Ka whangaia, ka tupu, ka puawai
That which is nurtured, will blossom, then grow

Omega 3: Hints for parents

- Act positive about taking the fish. Talk about 'fish time' like it's an enjoyable thing. Children can pick up on negative tone and body language.
- Give options of taking the fish by chewing the capsule or cutting it open and putting it in a cup with juice.
- Keep explaining that the fish is going to make their brain feel better.
- And don't refer to medicine as a lolly. Never do that; you don't want them to seek it out and risk overdosing, or thinking that medicine is a lolly. Lollies don't make you feel better.
- As it is such a long time, you might need a reward system. In addition to verbal praise, give kids a sticker and put it on a calendar after they take the fish. They will feel rewarded, and they will also be able to follow their progress visually on the calendar.

<u>If the child does not like the flavour:</u>

Some taste-deflection tips include coating the tongue with syrup or giving the child something cold, like a Popsicle, before they eat the fish, or washing away the taste quickly with something sweet after they take the fish.

Try putting the fish in the fridge. It might taste better cold.

Mix it with juice.

University of Canterbury Foundation   Canterbury Primary Principals' Association   Rātā Foundation

Figure 8.13. Information given to parents about the Smart Bites Omega 3.

UC UNIVERSITY OF CANTERBURY Te Whare Wānanga o Waitaha CHRISTCHURCH NEW ZEALAND

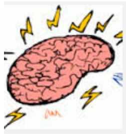
Strategies for Juniors Settling into School and Learning

Ka whangaia, ka tupu, ka puawai

That which is nurtured, will blossom, then grow

This is a FISH for your brain, not your tummy.

When you were very little, earthquakes swarmed over Canterbury for about one and a half years. This is a very long time for young children.



This was while your brain was growing. Some children have noticed that their brain can feel hot or fuzzy at times.
Or like an "electric storm".
Or even jumbled up and nervous.

Some children have trouble sleeping or staying dry at night.

We don't know exactly what is going on in children's brains – that would take a lot of special equipment or some magic!

But, some scientists have found that a special kind of liquid from fish might help children's brains feel calmer.
Like they are in a cool place.

A calmer brain will be a stronger brain.
It can make it easier to sleep and to remember things and to cope with everything going on around you.

Taking ONE FISH a day might help.

We're not sure. But it could help.

But you would need to take it EVERY DAY for **183** days.

That's a lot of days!

Because your brain is so important and complicated, it can take a long time to start to feel better. That is why it takes so long. So, even if you get tired of the FISH, remember, the FISH is trying to help your brain.

Your parents are the best people to talk to about this.

University of Canterbury Foundation   Canterbury Primary Principals' Association   Rātā Foundation

Figure 8.14. Information given to children by parents about Smart Bites Omega 3.

Conclusion of Presentation of Strategies to Principals and School Leaders

This concludes the recommended general strategies for the first step of the project. Although additional strategies were recommended to individual schools, these are actually better suited to steps two and three. These strategies will be considered in the next edition of this book.

I hope you have been at least surprised by these recommendations, which are quite different to the recommendations you may have heard from others.

Thank you very much for your attention and I am hopeful that can work together to create calmer and less stressful classrooms for teachers and children.

-----Kathleen Liberty, February 2016.

Grateful Acknowledgements: The initial implementation of the strategies described in this chapter was supported by donations from the Canterbury Primary Principals' Association, the Rata Foundation, and the Te Paeroa Cluster of Resource Teachers of Learning and Behaviour, Christchurch, New Zealand.

Chapter 9
Implementation and Effects of Step One Strategies[15]

Methods

Study Design

The principals of the strategy schools learned about the recommended strategies in Term 1 of 2016 and began discussing these with the teachers and staff at their schools. Schools made a range of decisions about implementing the individual interventions that comprised the Step One Strategies, and implementation of many strategies began in Term 2.

At the end of the year, the Juniors Settling Into School and Learning study continued with its end-of-the-year teacher report. The data from that round of teacher reports were used to provide an evaluation of the Step One Strategies by comparing the results with the data collected at the end of 2015 (the data from 2015 are discussed in Chapter 4.)

This is a quasi-experimental design or an evaluation design and is not a controlled experimental analysis of the strategies collectively or individually.

Jacob Bor (2016), from the Departments of Global Health and Epidemiology at Boston University School of Public Health, has described the importance of natural experiments. Although the present study is not a natural experiment, because the exposure to the interventions was actually determined by the principals rather than occurring 'naturally', some of the advantages described by Bor would seem to apply. Exposure refers to the

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[15] A version of this chapter was presented at the 10th Educational Psychology Forum, Wellington, New Zealand on 28 November 2017; Victoria University of Wellington.

population being given access to or receiving, the intervention (Bor, 2016). In the present study, the “exposure” of the children to the strategies was determined by the decisions of schools, teachers, and, in the case of omega 3, by parents. The decisions by the principals and school leadership meant that there was a range of exposure across school communities. In contrast, in a Randomised Controlled Trial, for example, researchers control and monitor the intensity of exposure to interventions; implmentation intensity is not ‘naturallly’ determined by the ‘consumers’ or study participants. Bor (2016) argues that studying a range of exposures that occured naturally in an environment can provide important information about intervention effects because it is more likely to reflect the ‘real world’ in which population-level interventions will be established, in contrast to the tightly controlled world of the RCT. This argument might also apply to the current study.

Quasi-experimental designs are also advantageous in situations in which random assignment to intervention groups is not possible (Bor, 2016). Although random assignment to an intervention and a non-intervention group is a requirement of a RCT, this procedure is not possible for some interventions due to the nature of the intervention or ethical considerations. In the present context, an RCT was not available for several reasons. (1) Schools felt the behaviour problems, and school stress levels had reached unmanageable levels, and a delay to plan an RCT, including possibly recruiting control schools and collecting baseline data was not acceptable. Such a delay was likely to be associated with a further increase in problem behaviours. (2) Schools in the project had volunteered their participation and were not randomly selected, which affected their suitability for any RCT. Also, strategies involved the whole school, so selecting classroom-level randomisation would not be possible. (4) Random assignment by an experimenter undermines the authority and leadership of the school principal. (5) Even a wait-listed control group could be regarded as having a negative consequence as it would delay access to the interventions for some children.

The present study further fits Bor’s (2016) description, because the differences between schools in the adoption of interventions provided variation in exposure to the intervention, and this variation was able to be observed and documented. In addition, because of the continuation of the data collected in schools (Chapter 3), the collection and analysis of the same data after the implementation of the Step One strategies would provide a natural evaluation of their impact.

The quasi-experimental design used an interrupted time series (Bor, 2016), in which the data collected prior to the principals’ implementation decisions served as the baseline pre-

intervention. Data collected by teacher-report at the end of the year following the implementation of the strategies were used to analyse Step One strategies. Similar procedures will be used to analyse subsequent steps of strategy introduction. However, the study design had many limitations, as described later in this chapter.

Participants and Measures

The participants and measures in the quasi-experimental design were as described in Chapter 3.

The school-level characteristics are shown in Table 9.1 (pseudonyms are used for school names). The school decile, year levels included in the school and roll are publicly available. All schools had buildings that were damaged in the earthquakes, and of course, these had been repaired prior to re-opening. The repairs generally increased the flexibility of the learning spaces, for example, by removing or widening doorways. From 2012 through 2016, all schools in the project were in traditional New Zealand single-cell classrooms, but some schools had modifications, such as widening doorways and removing walls between some classrooms.

Table 9.1 Characteristics of Study Schools at the start of 2016

Characteristic	**Alpha School**	**Beta School**	**Fantail School**	**Tui School**	**Kauri School**
Years (Grades)	1-6	1-8	1-8	1-8	1-6
Roll	480	350	450	450	300
Decile	High	Mid	Mid	High	Low
Families with High Stress	44.4%	61.2%	47.9%	52.3%	52.6%
Children with Sleep Problems	58%	78%	66%	79.4%	79.5%
Children with 0 Behaviour Problem Scores at school entry	38.8%	45%	31.6%	26.4%	18.9%
Children with combined 8-14 and 15+ Behaviours Problem Scores at school entry	16.4%	6.7%	15.8%	31.9%	48.7%

School Alpha had slightly fewer study families reporting high stress and children with sleep problems. School Beta has the most parents reporting high stress and the most children with good self-regulation as they started school (i.e., 0 BPI scores). Schools Beta, Tui and Kauri have almost 80% of the children having sleep problems by parent report.

Intervention Implementation

The interventions offered to schools were the "Step One" strategies, as described in Chapter 8 (Table 9.2) Resourcing was made available through donations to cover the costs associated with implementation, such as the cost of teacher professional development material, RIRO for principals, drink bottles, wholemeal snack and omega 3. It was estimated that the first step would involve five to eight weeks for planning and initial implementation, after which time schools might see an initial reduction in behaviour problems over the subsequent six or more months.

All of the schools participating in the Juniors Study were invited to participate in the Strategies Project in September/October 2015.

Analysis Plan

The analysis plan was to use the same teacher-report data analysis as previously described (Chapters 3 and 4) in order to determine the impact of strategy implementation, considering changes in the prevalence and means of behaviour problems. The variation in exposure achieved by the implementation decisions of the school leadership provided a valuable opportunity to evaluate the strategies in a range of intensities of adoption.

Implementation Score

As a rough guide to indicate differences in exposure to interventions between schools, an Implementation Score was calculated based primarily on the total number of strategies implemented, with one 'point' per strategy (Table 9.2). However, schools that modified or delayed a strategy, for whatever reason, were given a half-point for that strategy. One point was also given for each school term (10 weeks) of implementation, up to a total of three terms. The strategies were recommended to schools in Term 1, and the rest of Term 1 was available for discussion, decision and planning.

The effects at school level were determined using all of the study children attending school during the teacher-report period. The second tier of analysis focused on a subset of study

children by implementation group. This is because the schools were very interested in whether the movement of some study children out of the school, for instance, a child with many behaviour problems, would 'artificially' inflate the impact of the strategies. In order to address this concern, a subset of study children was identified to include only children who were studied from school start to the end of 2016.

Results

Implementation Decisions

School Alpha declined to participate in the strategies project, because, as the principal explained, the staff were tired of trying new things since the earthquakes and had decided to keep the status quo for 2016. School Beta had wanted to participate, but the resignation of the principal and delays in finding a new principal meant that some strategies were not introduced until the fourth term.

The decisions by the schools, under the leadership of the principal, are shown in Table 9.2.

Professional Development

Two audio-visual recordings explaining the school profile (data collected from the project, as described in Chapters 3, 4 and 6) and the recommended strategies and their rationale (as described in Chapters 7 and 8) were presented to the principal and senior staff, who then determined pathways of communication to the teachers. These recordings were able to be shared with the schools.

Teacher Well-being

Each school determined a strategy, or series of strategies for teacher well-being. In two schools, some teachers requested adult omega 3, which was provided. In one school, teachers established well-being groups and engaged in shared activities (e.g., yoga) to reduce stress. In some schools, teachers made individual choices regarding steps to combat stress.

Principal Well-being

Three principals, the Cluster Manager of the RTLB service, and a research assistant, attended RIRO training at the start of Term 3, 2016. They were asked to impletment the RIRO techniqiues in their own interactions during terms 3 and 4 in order to determine the suitability of RIRO training for their teachers as a Step Two strategy for the project.

Calm-Down Room Decor

The implementation of these strategies is shown in Table 9.1. A √ indicates that the school reported the majority of the classrooms (or all) had significantly reduced wall decorations, and all had removed hanging decorations.

Wall Colour

The proposed trial of blue paper on the walls was not able to be implemented, as the manufacturer stopped shipping the nominated product to New Zealand on 1 March 2016, so that no school was able to implement this strategy.

Light Levels

Of the four recommendations, two were felt to be 'doable' and two were not implemented due to resourcing and rejection by staff. The two that school principals identified as possible were (1) Remove decorations from windows and (2) seat children with problems in reading, writing or maths near the windows. However, the other two strategies were not considered feasible to implement. Teachers pointed out that keeping window curtains open during learning times was not always possible, as curtains were needed to screen out bright sunlight at certain times of day, which made the rooms over heated and glary. Children also complained of sun-strike. Teachers also felt that turning on overhead lights during learning times was not always suitable, as many of the light fixtures were fluorescent tubes, which made annoying and distracting sounds, or gave off light that the teachers identified as not sufficient for learning in any event. This view was supported by research by Winterbottom and Wilkins (2009). Although principals had identified the possibility of seating children with learning problems near windows, teachers also pointed out that this strategy was not always doable. For instance, in some classrooms, there were no tables or chairs or learning spaces near the windows, due to the glare and heat. Another problem was that learning often happened in groups, and children with learning problems could not be separated from their groups. A final reason was that learning sessions often consisted of children moving from one activity-type to another activity-type, and this could include multiple classrooms. Therefore, of the recommendations for light, only removing decorations from the windows was considered to be 'doable' and implemented as shown in Table 9.2

Reduce Noise Using Visual Feedback App

At one school, the validity of the data on the sound levels collected at the end of 2015 was debated, with teachers generally identifying that there was no noise problem in their classrooms. A principal remarked that it was an individual decision if teachers wished to use the Too Noisy app. The Too Noisy app was trialled in three schools and rejected by the teachers that trialled it. The reasons for rejection of this strategy included: (a) The readings given by the app did not include decibel levels, so it was difficult to relate the data from the app to the school profile data to determine if the room was quieter than the profile. (b) The readings by the app did not take into account the different types of activities in the different parts of the room. For instance, if the teacher was standing next to the app while giving directions, the app gave 'artificially high' readings. (c) The children delighted in making the app dial reach the maximum, so the effect of the app was opposite to what was desired.

Play-Eat-Learn

According to the principals' reports, implementation of the Play-Eat-Learn schedule was the most challenging of all of the recommended strategies, confirming research by Price and Just (2015). Changing the school day had profound impacts on teachers' scheduling of their own breaks, mealtimes and playground supervision duties. Also, getting the schedule adjusted to fit the constraints associated with other aspects of the school day was not something achieved on the first iteration. One school made three adjustments before identifying the best schedule.

Kauri School also reported that children's behaviour during morning playtime deteriorated when they played before the morning tea snack. This school had the most children in the Friday-only breakfast programme and was the only low decile school, so it is entirely plausible that behaviour did deteriorate during playtime, as it was very likely that many children did not have breakfast. Thus, their behaviour would deteriorate as long as playtime came before morning tea, as the length of time without eating would have been longer.

One school had made adjustments to their timetable about five years previously and were happy with that. However, upon discussion with the staff, Fantail School did adopt the Play-Eat-Learn schedule for the morning, and retained their original schedule for the afternoon. The acting principal of Beta School determined such a significant change would not be able to be implemented until a new principal was appointed. Thus, Play-Eat-Learn was not implemented until Term 4 in Beta School.

Drink-to-Think, Think to Drink

Kauri School was the only school adopting the Drink to Think-Think to Drink programme at the start of the implementation period, while Beta School implemented the strategy in week 2 of Term 4. Both of these schools received named drink bottles for each child, and Beta School also received some water bottles for children to use outside during sport (provided free as a promotion by the company from which the Omega 3 was initially ordered).

Both Fantail and Tui Schools asked parents via a newsletter to provide water bottles for their child to use at school, and the project provided (unnamed) water bottles for the principal to give to students whose parents had not supplied one. Four of five schools made water bottles available to children.

Figure 9.1 Water Bottle Strategy! (Photo Credit: Kathleen Liberty).

Wholemeal+ Snack

Kauri School was also the only school adopting the Wholemeal+ Snack programme near the start of the implementation period, with funding supported by the donations to the project. The funding supported purchasing the bread and spreads, and the cost of a teacher aide's time

to prepare the snack on a daily basis. This school also worked with a charity providing children's lunches to get them to switch to wholemeal bread instead of white bread.

Both Fantail and Tui Schools asked parents to provide additional food in their child's lunch boxes, and Tui school identified this as complex carbohydrates. However, whether or not additional food was provided, and the nature of this food, is not known.

In addition, Kauri and Fantail readjusted the timetable of their fruit and milk programmes to fit within the Play-Eat-Learn Schedule.

Fantail, Tui and Kauri schools also had additional food available for children who showed up at school without lunch, continuing their usual practice. The wholemeal loaf was then introduced into this option.

Parent Information

Four of the five schools (not Alpha School) shared information about the strategies in the school newsletters.

Child Dietary Supplement Omega 3

Four of the five schools (not Alpha School) implemented the omega 3 strategy. Fantail school gave all parents information about Omega 3 in the school newsletter and invited interested parents to contact the principal. At the other schools, parents of selected children were offered a trial of Omega 3. At Kauri school, children taking Omega 3 were given a star chart by the principal, and asked to bring it in on a weekly basis to receive a small prize if the chart were completed. Schools reported that between 20-25 families took up the offer of free omega 3. Some schools reported that other parents had told them of purchasing and using the omega 3 at home. Sufficient Omega 3 was provided to schools for a 9-12 month supply for identified children.

Table 9.2 Implementation of Recommended Strategies, 2016.

Recommend-ation	Strategy	Alpha School	Beta School	Fantail School	Tui School	Kauri School
Teacher & Principal Well-being	Professional Development	Opt-out	√	√	√	√
	Teacher Well-being	0	√	√	√	√
	RIRO for Principal	0	0	√	√	√
Calm Down Room Decor	Remove hanging decorations	0	√	√	√	√
	Reduce wall decorations	0	√	√	√	√
	Change wall colours	0	0	0	0	0
	Remove decorations from windows	0	√	√	√	√
	Seat children with learning problems near windows	0	0	0	0	0
	Open curtains during instruction	0	0	0	0	0
	Turn on lights during instruction	0	0	0	0	0
	Reduce Noise Using Visual Feedback App	0	0	0	0	0
Improve Health	Play-Eat-Learn Schedule	0	Term 4	½ Day	√	√
	Drink to Think-Think to Drink	0	Term 4	0	0	√
	Water Bottles	0	Term 4	√	√	√
	Wholemeal + Snack	0	0	Parent	Parent	√
Parent Strategies	Parent Information	0	√	√	√	√
	Child Diet Supplement Omega 3	0	√	√	√	√
Duration of Implementation	School Terms	0	1	3	3	3
Total Implementation Score		0	9.5	13	13.5	15

Implementation Groups

Implementation of the strategies was categorised as falling into two different groups. Group 1, Alpha and Beta schools, were identified as having no, or limited strategy implementation, and comprised the "Low/No Implementation Group. Although Beta School implemented strategies, they did not implement strategies addressing the second recommendation until Term 4, thus the categorisation of this school. Group 2, Schools Fantail, Tui, and Kauri implemented more than 75% of the strategies, and comprise the "High Implementation Group." Results by the group and by the individual schools are included in this chapter.

The next step was to determine the characteristics of children's behaviour prior to the start of the strategies project in these two Implementation Groups, to determine if their differences. This information is presented in the Results section of this chapter.

School Characteristics Prior to Implementation

Study Children's Behaviour Problems at the Start of School

One important factor that likely affected the adoption and eventual impact of the strategies was the prevalence of behaviour problems in the schools at the start of the study period (Table 9.3). The data in Table 9.3 indicates that the two schools in the Low/None Implementation Group had more children with zero behaviour problems, and significantly fewer children with combined 8-14 and 15+ behaviour problems as the children entered school, as compared with the Pre-Earthquake Group. However, in the High Implementation group of schools, there were fewer children with zero behaviour problems (indicating high self-regulation), and significantly more children with combined 8-14 and 15+ behaviour problems, as compared to the Pre-EQ group.

Table 9.3 Percent of Children by Behaviour Problem Score Category at the Start of School in the Pre-Earthquake Group, the Low/None Strategy Group (2 schools) and the High Strategy Group (3 schools).

Behaviour Problem Score Category	**Pre-EQ Group Starting School**	**None/Low Implementation Group Starting School**	**High Implementation Group Starting School**
Zero	36.0%	45.2%	29.5%
1-2	19.5%	21.9%	19.9%
3-7	28.3%	23.3%	23.0%
8-14	11.1%	5.5%	14.5%
15+	5.1%	4.1%	13.0%

Children's Behaviour Problems at the End of 2015

Another important factor that likely affected the adoption and eventual impact of the strategies was the prevalence of behaviour problems in the schools at the end of 2015, pre-intervention (Table 9.4). This table includes parent-report information that is associated with child behaviour problems.

Table 9.4 Frequency of High and Zero PBI Scores of All Study Children by School at the end of 2015, Pre-Intervention

Characteristic	**Alpha School**	**Beta School**	**Fantail School**	**Tui School**	**Kauri School**
Percent of Children with a Zero Behaviour Problem Score	48.9%	50%	38.9%	29.7%	18.2%
Percent of Children with combined 8-14 and 15+ Behaviour Problem Score	21.2%	22.0%	24.1%	23.1%	49.1%

There are several notable differences between the schools. Schools Alpha and Beta had more children with zero teacher-reported behaviour problems. School Beta has significantly fewer children with 8-15+ or more behaviour problems by teacher report at the end of 2015, but the most parents reporting high stress. School Kauri has the highest percentage of children with

8-15+ or more behaviour problems by teacher report. Schools Beta, Tui and Kauri have almost 80% of the children having sleep problems by parent report.

Behaviour Problems of A Continuing Group

The analyses focus on a sub-set of study children in order to follow the same set of children, and consider changes in BPI score category (Table 9.5). These data show little difference from the data for the whole school.

Table 9.5 Percent of Continuing Children by Behaviour Problem Score Category at the Start of School and at the end of 2015 by Implementat ion Group (same children at both time points).

Behaviour Problem Score Category	**None / Low Implementation**		**High Implementation**	
	Start School	End 2015	Start School	End 2015
Zero	45.2%	46.6%	29.5%	30.9%
1-2	21.9%	17.8%	19.9%	17.0%
3-7	23.3%	15.1%	23.0%	21.2%
8-14	5.5%	11.0%	14.5%	14.5%
15+	4.1%	9.6%	13.0%	16.4%

By the end of 2015, the proportion of children in the zero behaviour problems group had maintained in the High Implementation group and improved slightly in the None/Low Implementation group. However, the proportion of children in the combined 8-14 and 15+ behaviour problem group had more than doubled, to 20.6% in the None/Low implementation group. This is congruent with the overall study results reported in Chapter 4 that showed the increase in child behaviour problems between entering school and the end of 2015.

The children in the schools in the High Implementation group showed a much smaller increase in the proportion of children with combined 8-14 and 15+ behaviour problems, from 27.5% to 30.9% as compared to the No/Low group. However, the frequency of children in the combined 8-14 and 15+ group was still about 10% greater than the number of children with combined 8-14 and 15+ behaviour problem scores in the None/Low Implementation group.

Children's Behaviour At The End of Step One Implementation

In this section, the behaviour of the subset of children in the None/Low Implementation Schools is compared to the behaviour of children in the High Implementation Schools (same children at both measurement points).

Worsening of Behaviour in None/Low Implementation Group

There were very negative and concerning changes in the None/Low Implementation Group (Table 9.6). By the end of 2016, the proportion of the same group of children with zero behaviour problems had dropped by 33%, and the overall rate of children in the combined 8-14 and 15+ problem group had increased by 13%, with the greatest increase in the 15+ behavior problem score group.

Table 9.6 Percent of Children by Behaviour Problem Score Category at the Start of School, at the end of 2015, and at the End of 2016 in the None/Low Implementation Group (same children at all time points).

Behaviour Problem Score Category	**None/Low Implementation**		
	Start School	End 2015	**End 2016**
Zero	45.2%	46.6%	**31.2%**
1-2	21.9%	17.8%	**26.0%**
3-7	23.3%	15.1%	**16.4%**
8-14	5.5%	11.0%	**9.6%**
15+	4.1%	9.6%	**13.7%**

Overall, the profile of behaviour problems in the None/Low Implementation schools had come to resemble the pre-strategy status of the other schools at the end of 2015. Perhaps this may be because these children started school with fewer behaviour problems by teacher report but eventually showed the same pattern, or perhaps because more children at these schools were on a delayed individual pathway, or perhaps as the children got older, they encountered additional stressors in school or in families, or for other reasons. However, the overall picture of behaviour problems at these schools worsened during 2016.

Improvement in Behaviour in High Strategy Implementation Schools

The opposite was true at the High Implementation Schools, as shown in Table 9.7

Table 9.7 Percent of Children by Behaviour Problem Score Category at the Start of School, at the end of 2015, and at the End of 2016 in the High Implementation Group (same children at all time points).

Behaviour Problem Score Category	**High Implementation Group**		
	Start School	End 2015	**End 2016**
Zero	29.5%	30.9%	**39.5%**
1-2	19.9%	17.0%	**21.6%**
3-7	23.0%	21.2%	**18.0%**
8-14	14.5%	14.5%	**10.2%**
15+	13.0%	16.4%	**10.8%**

At the High Implementation Schools, following the first year of implementation of the Step One Strategies, and for the first time since children began school, the proportion of children with zero behaviour problems increased to 39.5%. This is a proportionate increase of 27.5%. This indicates that the implemented Step One strategies helped these children develop or improve their self-regulation skills.

If one or two behaviour problems are considered as an acceptable level, 55.5% of the Pre-Earthquake group had Behaviour Problem scores of 0-2, and, following the first year of strategy implementation, 61.6% of children scored in these categories. So, in terms of children with low behaviour problems, the High Implementation Group had bettered the Pre-Earthquake group (although these were five year olds).

Considering children with combined 8 through 15+ behaviour problem scores, this also showed an impressive result. For the first time since the children entered school, the proportion of children with high behaviour problems decreased. Although there were still 21% of the children with scores in the combined 8-14 and 15+ categories, this was a decrease of 32.9%!

Considering only the highest category, children scoring 15 and above, the decrease shown is 34.2%. Schools would certainly notice more than a third reduction in children with the highest level of behaviour problems.

School-Level Results

The percent change in the combined 8-14 and 15+ behaviour problems group by individual school (Figure 9.2, Table 9.10), and the percent change in children with 0 behaviour problems (Figure 9.9, Table 9.10) was examined by individual school in order to evaluate whether the change was related to strategy implementation. These results indicate that the effects may be directly related to the exposure variable since schools with higher strategy implementation scores showed better impacts s compared to schools with lower implementation scores.

Table 9.8 Percent Change by School in Zero and High BPI Categories

Characteristic		**Alpha School**	**Beta School**	**Fantail School**	**Tui School**	**Kauri School**
Percent of Children with a Zero Behaviour Problem Score	Pre	48.9%	50%	38.9%	29.7%	18.2%
	Post	27.6%	37%	44.4%	43.1%	30.0%
Percent of Children with combined 8-14 and 15+ Behaviour Problem Score Categories	Pre	21.2%	22.0%	24.1%	23.1%	49.1%
	Post	37.9%	17.4%	17.7%	12.5%	36.0%

The data shown in Figure 9.2 and Table 9.10 indicate that Alpha school, which implemented no strategies, had a substantial increase in children with combined 8-14 and 15+ behaviour problems. In contrast, Beta School, and all of the high implementation schools had a decrease in the proportion of children with high behaviour problem scores. There is a relationship between the amount of change and the degree of exposure to the implemented strategies: suggesting that in schools in which more strategies were implemented, there was a more substantial positive effect. However, Kauri School, with its greater numbers of children with combined 8-14 and 15+ BPI scores to begin with, has not shown as much an effect as Tui School.

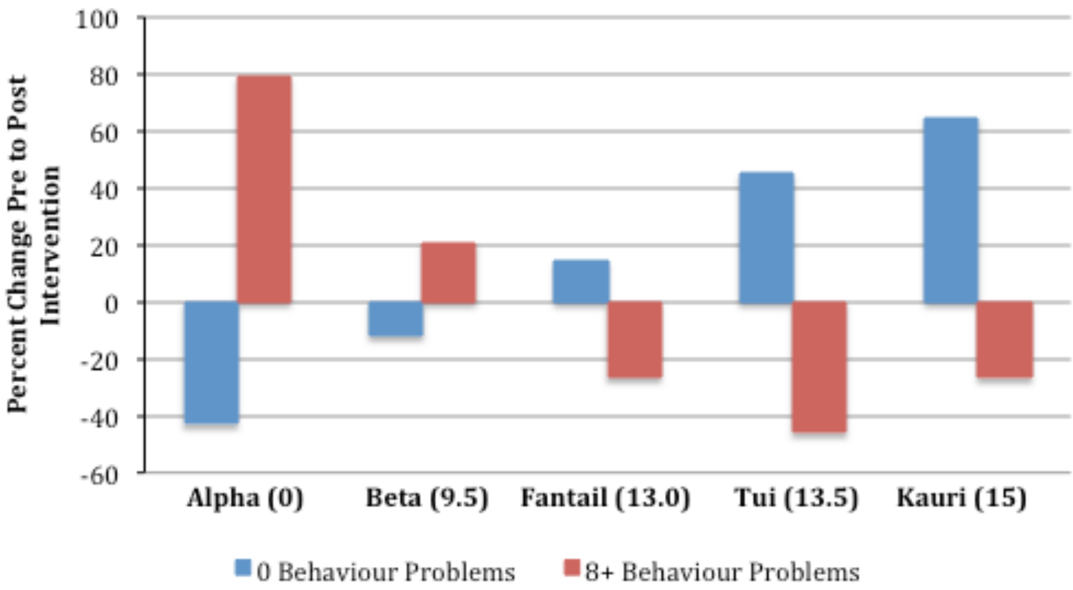

Figure 9.2 Percentage Change in Children with 0 Behaviour Problems (blue) and combined 8-14 and 15+ behaviour problems (red) in the schools, from the end of 2015 to the end of 2016. The same children are represented at both time points in the calculation.

The data shown in Figure 9.2 indicate that the two schools with None/Low Strategy Implementation had a decrease of more than 20% each in children with zero behaviour problems, indicating a decrease in children with good self-regulation.

However, the opposite resulut was shown in the High Implementation Schools, with beneficial changes relative to the degree of implementation. Tui and Kauri School, with the highest level of implementation, had the strongest positive changes.

Change in Prevalence of Children with Posttraumatic And Arousal Symptom

As the strategies aimed to promote calm and reduce arousal, the data were also examined to determine if the changes in the behaviour problem scores reflected changes in children with PTS and arousal symptoms. The data shown in Table 9.9 indicates a similar pattern to previous results, with Alpha and Beta Schools showing a negative reduction in children with zero scores, and Fantail, Tui and Kauri showing positive increases in the prevalence of children with zero teacher-reported PTS or Arousal symptoms.

Table 9.9. Percent Change in Children with Zero PTS and Zero Arousal Symptoms by School

Characteristic	Alpha School	Beta School	Fantail School	Tui School	Kauri School
Children with 0 PTS Symptoms	-41.7%	-18.4%	+14.7	+50%	+65%
Children with 0 Arousal Symptoms	-37.8%	-10%	+6.3%	+19.4	+44.1

Changes in Mean Scores

Changes in mean scores are calculated to show a different, complementary, impact of the strategies. Principals and teachers are more interested in the frequency of children with behaviour problems, as, in their experience of teaching children, they differentiate by the number of children with behaviour problems in their school or classroom. An average across the school does not appear as meaningful as the number of children with behaviour problems.

The mean change in school BPI scores, PTS and Arousal symptoms show similar patterns of change, with increases in the No/Low Implementation schools and decreases in the High Implementation schools (Figure 9.3). In the three High Implementation schools, the mean change was from 6.8 behaviour problems per pupil at the end of 2015 to 4.8 per pupil at the end of 2016 (p=.001**). This is an average reduction of 2 behaviour problems per pupil.

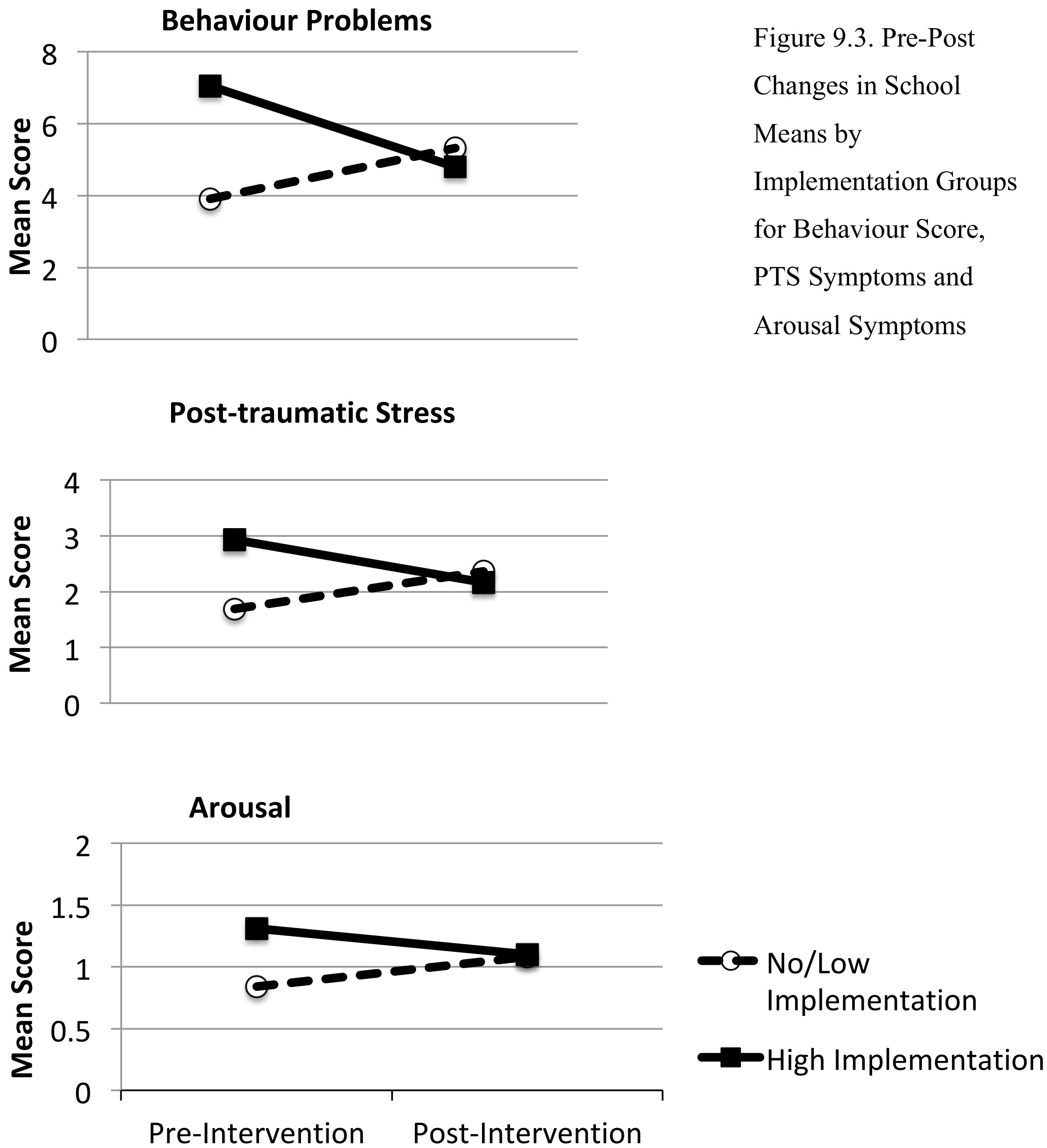

Figure 9.3. Pre-Post Changes in School Means by Implementation Groups for Behaviour Score, PTS Symptoms and Arousal Symptoms

Quality Assurance

Quality-Assurance: Intervention Strategies

Of the seventeen strategies shown in Table 9.1., only wall-colour changes were not able to be implemented due to lack of suitable resources. This left 16 strategies. Of these, three were not implemented by any school (13 of 16, (81.3%). The strategies that were less likely to be adopted were the Drink To Think, Think to Drink programme (2 schools) and the Wholemeal+ Snack (1 school).

Overall, of the 16 potential strategies, Alpha school declined to implement any strategies, although they received a second invitation in 2016 when the annual school report was provided to the principal. This school did not receive a list or description of any strategies because they had rejected participation in the project before the end of 2015 (Chapter 6).

Considering the four schools that received strategies, the sets of strategies for the Calm Down the school environment and the Omega 3 strategies were implemented by all of the schools. Thus, these strategies have strong quality assurance. The strategies associated with child health, including Play-Eat-Learn, and the water and wholemeal snack programmes, were more challenging for schools. Although Tui and Fantail schools did not reject the strategies, the school community did not see the school as needing to be the provider of water and food in addition to their usual practices and felt that parents could support this change once information had been provided to them. In addition, parent-provision was sustainable in schools in these mid and high decile neighbourhoods, but school budgets could not sustain the costs of sole-school provision beyond the end of the resource period.

Quality assurance can be estimated using an alternative metric based on the implementation score. Overall, if all five schools had implemented all 16 potential strategies for 3 terms, a total perfect implementation score of 95 was possible. Considering all of the schools, the total achieved implementation score is 51 (53.7%). If only the four schools who actually received descriptions of the strategies and the rationale for their implementation are considered, the overall implementation score is 51/76 (67.1%). It is not clear how to interpret this score, as this type of analysis has not been reported in comparable studies.

Quality Assurance: Social Validity

Social validity, or "consumer satisfaction" of the goals, methods and outcomes of intervention is an important factor in whether evidence-based practices are selected and implemented in educational settings (Cook & Odom, 2013; Kazdin, 1977; Rapp et al., 2010). In this regard, principals discussed their perceptions of the strategy impacts. One principal shared the email received from a parent, which described the positive impact of the changes on the at-home behaviour of her children (Figure 9.4).

Another quality assurance step was to ask principals at the end of 2016 if they planned on continuing the strategies in 2017. The principals of the four schools who had implemented strategies all said they would continue them. The principals made this decision in November of 2016 based on their own experiences in the schools, without the benefit of the end of 2016

data. This was a very significant social validation of the goals, methods and impact of the strategies.

May 2017

*Hi Christine**

As we discussed this morning, the new play/eat arrangements are working really well for my boys. X and Y are far more pleasant in the afternoons.

Previously after school time has been very fraught with lots of meltdowns and frustration from both boys. They would come around after a huge afternoon tea and lots of downtime, but it was very stressful for everyone.

The difference over the past week has been huge. The boys were clearly tired after their first week back, but still coping well with life which is a much appreciated improvement! We've had conversations on the way home instead of tears. Afternoon tea is a pleasant shared catch up time, not a desperate attempt to shovel food into them while they argue with each other. They're much more able to independently play and get started on their own activities - even playing together without much fighting! ...has even expressed interest in completing some home learning where previously he would be 'too tired'.

I can only put this down to the change in the eating schedule. I'm putting a lot more into their lunchboxes and it is all being eaten. They're not ravenously hungry when they get home.

While this outcome is not the main intention of the new arrangements, I can only imagine you're receiving some of these benefits at school too.

I'm a fan.

Figure 9.4. Email from a parent received by a principal several weeks after the implementation of strategies.

Quality Assurance: Generality of Results

One approach to validating the quality of the results in a quasi-experimental design using an interrupted time series analysis can be identified by whether the results reported on the study children (research sample) can be generalised to the school as a whole.

The results described in this chapter were shared with the principals in March 2017. At that time, the principals of four schools confirmed that the data from the study children matched up with their overall analysis of the behaviour in their school by the end of 2016 (the principal

of Alpha School declined to participate in the discussion). We also discussed whether it was possible that the results had been influenced by teachers' perception of the strategies and their overall purpose. However, it is very unlikely that these results are due to the teachers in the High Implementation group reporting overly positive results, because, as the principals admitted, the teachers were not informed that the changes at the school, for instance, Play-Eat-Learn, were related to the Juniors Study. Also, when the data were collected at the end of the year, teachers would have become accustomed to the strategies and are very unlikely to have associated them with the child's behaviour at the time they were completing the reports. In the anecdotal notes provided by the teachers, not a single note mentioned Omega 3, water bottles, scheduling changes or anything that could be construed as being related to the strategies. Finally, the changes were reported across many teachers, not just one or two. Thus, the principals and others involved have confidence that the results of this quasi-experiment accurately reflect the impact of the Step One Strategies.

Quality Assurance: Replication of Interventions

In May 2017, the results of the Step One Strategy Implementation were shared with local principals at the invitation of the Canterbury Primary Principals Association, who had donated funding to support school implementation. Following this presentation and subsequent meetings, nine primary schools and six early childhood centres volunteered to trial the Step One Strategies in their schools to determine if the results could be replicated. These schools serve more than 4,000 pupils. At present, baseline data collection of a randomised sample from each school and preschool is underway, under the leadership of the Te Paeroa RTLB Cluster, led by the manager, Maureen Allan and Liz McNaughton. A high school principal has also expressed an interest in adapting strategies as appropriate for their pupils' age levels.

A description of Step Two and Step Three Strategies, and the details of the replication schools will be reported in the next edition of *Calming and Coping in Schools*.

Discussion

The results of the quasi-experiment show that the implementation of the Step One strategies produced a 27.5% increase the proportion of children with zero behaviour problems as rated by their teachers in schools with high implementation levels. The schools that did not implement the strategies, or reported a low or delayed implementation reported a 33% decrease in children with zero behaviour problems. Children with zero behaviour problems

may be identified as children with strong self-regulation skills. As these are the same children followed from school entry through the end of 2016, and since such an increase has not been shown previously, this is significant evidence as to the impact of the Step One strategies. The fact that the schools that implemented more of the strategies had greater effects gives weight to the fact that the strategies were the proximal cause of the change.

The quasi-experiment also shows that the implementation of the Step One strategies produced a 32.9% decrease in children with combined 8-14 and 15+ behaviour problems. Over the same period, schools that had no or low implementation saw an increase of 13% of children in the combined 8-14 and 15+ behaviour problem score categories. As these are the same children followed from school entry through the end of 2016, and since such a decrease has not been shown previously, this is strong evidence as to the impact of the Step One strategies, which was an average reduction of 2 behaviour problems per pupil. The fact that the school that implemented 12 of the 13 possible strategies had a larger proportionate increase in children with zero behaviour problems points out the importance of considering Step One strategies as a holistic package. The results for Beta School also suggest that the duration of implementation is important. Considering both Beta and Fantail Schools, the results also suggest that Play-Eat-Learn, implemented throughout the school day and over several school terms, may be an essential element in achieving additional benefits from the strategy implementation.

Bicultural Limitations and Strengths

This study is limited in that the interventions have not been reviewed for cultural acceptability or studied according to Kaupapa Māori processes (Macfarlane & Macfarlane, 2012; Mane, J., 2009; Walker, Eketone, & Gibbs, 2006). This is important because Maori may be especially vulnerable to the effects of traumatic events, as many experience additional adverse events associated with inequality, poverty and racism; particularly racism in housing and health services (Flett, Kazantzis, Long, MacDonald, & Millar, 2002; Marriott, & Sim, 2015). Hirini, Flett, Long, and Millar (2005). and Reid, Taylor-Moore and Varona (2014) reported that Māori are also more likely to experience traumatic events, including historical trauma.

Te Whare Tapa Whā is one Māori model of well-being that metaphorically rests on the four walls of a whare, as described by Mason Durie (1994: Ministry of Health, 2017a). These "walls" are Taha Tinana, Taha Wairua, Taha Whānau and Taha Hinengaro. Although these terms are not easily translated into English, they may be considered as representing the

dimensions of physical health, spiritual health, family health and mental health. On the positive side, the interventions, considered as a package, provide positive support to children from professionals for health and well-being, which is a key to resilience for Māori (Lambert, Mark-Shadbolt, Ataria, & Black, 2012).

In terms of diet, Maori traditionally ate Toheroa (paphies ventricosa), which is high in Omega-3, and many other kinds of seafoods as a staple of their customary diet, but dietary changes in the 20th century, and the apparent collapse of some seafood habitats seem to have reduced fish and shellfish consumption (Anthoni, 2009) and may have resulted in Omega-3 deficiencies. This information may be useful in cultural responses to the suggestion of Omega 3 dietary supplement (Rei & Hibbeln, 2006).

The whare model reminds us that well-being is not something that can be parcelled out or divided up and that mental health is always entwined with physical health. Supporting child health is respectful, and does not have implicit blame that is inherent in some behavioural parent-training interventions.By addressing both Taha Tinana and Taha Hinengaro, the inventions in the present study indicate one possible pathway toward acceptability for Māori. This model is also a reminder that it is not sufficient when planning interventions to consider only one aspect of stress, such as psychological impacts, but strategies must seek to improve holistic well-being as mental health cannot be separated from physical health or other factors.

Additional Limitations and Strengths

The limitations reported for the Juniors Study (Chapter 4) also apply to this evaluation, as the data measures used in that study were used to indicate the effect of the strategy implementation, and there were additional limitations in the present quasi-experimental study of the strategy implementation. There were also some limitations to the measures (e.g., lack of multi-informant measures) and there was lack of randomisation (Liberty et al., 2016). Because the EQ-Exposed study group had proportionally fewer children from high deprivation neighbourhoods as compared with the Pre-EQ study, the present study was more likely to underestimate the prevalence of Posttraumatic Stress and, also underestimate the effects of the strategies. These limitations weaken the study.

It was not possible, for example, to randomly select schools in the environment of on-going aftershocks and changes announced by the Ministry of Education. Similarly, since Play-Eat-Learn involved changing the entire school schedule, and since children in all schools moved

from room to room during each school day, it was not possible (nor desirable) to randomly assign classrooms.

Principals' control over implementation decisions is a likely contributor to the successful implementation of the strategies in 2016 and their decision to continue these for the 2017 school year, which may also be both a limitation and a strength. In controlled RCT, principals do not normally have control over the implementation decisions to the extent in the present study. This lack of experimental control has been noted as a limitation of the present study. However, providing each principal this decision-making role has likely contributed to embedding the strategies into the schools, and the decisions to continue with the strategies before the data that revealed the impacts were available.

Limitations in Measuring Implementation

One limitation of this quasi-experiment is a lack of any conventional measure of fidelity of implementation. The implementation score used to estimate implementation in this study is based on anecdotal information. In controlled experiments, it is essential that interventions be implemented as precisely as possible, and the fidelity of implementation is independently measured. However, this need for precise implementation for experimental control is one of the limitations in translating interventions into the 'real world', where such tightly controlled conditions are not possible. Attempting to quantify how the schools implemented the strategies using the Implementation Score is one limitation of this study because it cannot provide an assurance that the strategies were implemented with fidelity. The Implementation Score may also be seen as a strength because it is a measure of adoption, as recommended by Glasgow and colleagues (2003, 2004, 2007).

Another limitation in regards to the Implementation Score has to do with its sensitivity. As there were no metrics or research available for indicating the relative "weight" or importance of any given strategy, all strategies were considered to contribute equally to the effects of the intervention. While this aligns with research on protective factors, which, similar to risk factors, have a cumulative effect, rather than a weighted effect (Klasen, 2015; World Health Organization, 2014) there is no empirical evidence to support this approach. For example, it may be that Play-Eat-Learn was less important than removing hanging decorations in reducing symptoms. With the present study, there would be no means of determining this. However, exploration of such factors would be of enormous usefulness for schools, as

removing hanging decorations is much easier to implement than changing the school schedule. Therefore, a more controlled experimental study of the interventions is required.

Did the Intervention "Cause" the Changes?

Due to the absence of a method of quantifying fidelity and due to a lack of typical experimental controls for quasi-experimental designs (Barnighausen et al., 2017), the possibility that the results obtained may not be due to the strategies must be considered. The results may be due to other factors, such as, perhaps, changes in teaching style between the schools or natural recovery rates after a disaster. Although it would seem unusual that children attending Alpha and Beta schools showed less "recovery" as compared to children attending Fantail, Tui and Kauri schools, given that children had the same general disaster exposure and age range, it is a possibility that cannot be ruled out in a quasi-experimental design. Continuing data collection during 2017 to 2018, and data from the replication schools may provide additional relevant information concerning the reliability of the results.

Limited Comparisons

Interpreting the results of this quasi-experiment is also limited by a failure to identify a suitable comparison in the published literature. Although it is perhaps inappropriate to compare the results of a this quasi-experiment with results of other school-based studies, particularly as the results represent only the first step of a planned three-step intervention sequence and follow-up results are not yet available, such comparisons are commonly discussed in experimental studies. Tol and colleagues (2014) conducted a clustered randomised controlled trial of the effects of a multi-tiered intervention, including universal, targeted and indicated strategies with 329 children affected by war, and found no significant reduction in PTSD symptoms, as compared to the small to moderate change in the present study. However, the intervention studied included targeted and individual treatments. It was the hypothesis of the present study that targeted and individual treatments would be more effective and durable if the general level of classroom behaviour problems was reduced prior to the introduction of targeted interventions. Therefore, the results of the Tol et al study (2014) would be more relevant following the introduction of Step 2 and 3 of the planned interventions.

Pfeferbaum, Varma, Nitema and Newman (2014) reviewed whole school interventions. They identified that whole-school interventions had only been studied as preventative strategies (i.e., before an adverse event). After a traumatic event, studies showed that whole-school

interventions were almost entirely CBT-based and delivered to groups of targeted students by clinicians or specially trained facilitators. Thus, the reviewed studies are not comparable to the present study.

Similarly, Brown and colleagues (2017) identified 36 studies, 15 of which were conducted after natural disasters. Of the studies, interventions included CBT, EMDR, narrative exposure therapy and a classroom-based programme. The classroom-based programme, ERASE-Stress, which had been evaluated in several studies, was a 12-15 session programme delivered by a trained classroom teacher as part of the school curriculum aimed at reducing PTSD in war-affected Israeli seventh and eighth grade students, aged 12-15 years. This programme produced moderate to large effects in reducing PTS symptoms but was not comparable to the present study due to the difference in age range, and requirements for the teacher to deliver additional instruction.

A study of high school students who experienced the Great Japan Earthquake and Tsunami of 2011 included offering students an intervention based on a similar model to ERASE, which included elements of CBT, mindfulness, relaxation training, and coping skills (Okuyama, Funakoshi, Tomita, Yamaguchi & Matsuoka, 2017). The intervention was delivered individually by teachers, deputy principals, school nurses and school counsellors delivered the sessions. About 20% of the students showed positive effects, but more than 37% showed no effects even after two deliveries of the intervention.

An entirely different intervention, identified as non-verbal art and play activities, and suitable for grade four students (61.8% girls) who had experienced the Sichuan Earthquake, was delivered about once per month by specially trained art teachers and therapists (Ho, Lai, Lo, Nan & Pon, 2017). The researchers report that, unfortunately, there were no significant results.

Zakszeski, Ventresco, and Jaffe (2017) have critically reviewed the literature on school-based interventions and identified the need for new approaches because the existing approaches “incorporated largely reactive, direct services to students provided by external clinicians or researchers” (p.316). In particular, the researchers identified the importance of educating school personnel about the effects of traumatic events, not only in terms of improving the adoption of strategies but because “student outcomes may differentially improve and sustain when interventions are implemented by school personnel with whom students have consistent contact.” (p. 317). This is the approach taken in the present study, with the schools determining the most relevant interventions and how best to implement them.

As this chapter is prepared, studies with a similar approach to assisting a community of children affected by a long series of disasters and disaster-related events have not been identified. Thus, the results of this quasi-experiment are challenging to contextualise within the existing literature.

Strengths

A major strength of the approach described in this book is the innovative combination of evidence-informed strategies in schools to address the biological symptoms of post-traumatic stress of children who had experienced a very extended period of earthquakes, floods, and other disaster-related events.

In comparison with other studies, these strategies do not rely on professional clinicians and do not require teachers to engage in additional teaching activities. The innovative strategies are suitable for all children in a primary school setting and require few additional resources. All of these considerations are especially important in a community struck by disaster, with limited mental-health resources and clinicians. The quality assurance procedures, results and adoption of the strategies are additional important characteristics of the strength of this quasi-experiment.

Implications

Possibility of Improved Brain Function

Studies have shown that positive intervention results can improve brain function associated with some mental health problems (Davidson & McEwen, 2012). The results of this quasi-experiment are encouraging, because reducing behavioural problems associated with PTS may provide a developmental window for improvement of amygdala and hippocampus functioning, as these continue developing at least until age 18 years (Tottenham & Sheridan, 2010).

Studies have shown that positive intervention results can improve brain function associated with some mental health problems, including PTSD (Davidson & McEwen, 2012, Zhu et al., 2017). The non-psychological interventions used in the present study may also be associated with improvement in brain functioning. Hydration with 150 ml water to individuals in a 30°C environment produced significant changes in the parts of the brain associated with stress, including the amygdala, and improved mood and cognitive function (Young, Johnston & Benton, 2017). Children with ADHD have recently been shown to have disrupted circadian

rhythm (Coogan & McGowan, 2017), and omega 3 has shown promise in re-regulation of dysregulated circadian rhythm in children with attention problems associated with ADHD (Buchhorn et al., 2017). These studies are a few of the indicators of the potential positive changes that may be associated with the study strategies.

Outcomes of Traumatic Exposure

- DSM-5 includes a new category, Trauma and Stressor-Related Disorders, resulting from traumatic exposures. These ailments include attachment disorder, disinhibited social engagement disorder, adjustment disorder, acute stress disorder, posttraumatic stress disorder (PTSD), and PTSD for children 6 years and younger.
- Traumatic exposures are also associated with separation anxiety disorder, persistent complex bereavement disorder, mood disorders, disruptive behavior disorders, borderline personality, psychoses, somatoform disorders, and substance abuse disorders.

Frederick Stoddard (2014, p. 243).

The strategies may be helpful for children who have experienced other types of adverse events and developed similar symptoms. For example, Mackey and colleagues in The Imagen Consortium (2017), have identified that similar regions of the brain are implicated in the antisocial behaviour of young people and that young people who engage in antisocial behaviour are highly likely to have suffered adverse events in early childhood. Aghajani and colleagues (2017) have recently reported that young offenders who seem callous and unemotional also have experienced adverse childhood events, and have dysregulated brain function in similar brain regions, affecting their ability to understand important aspects of their environment and to learn. Dawson and colleagues (2012) have reported that early intervention that uses behavioural shaping techniques with young children aged 18-30 months with autism has positive effects on their brain activity, and Aylward and colleagues (2003) have reported that instruction has produced positive changes in the brain pathways of children with dyslexia. Depressed adolescents showed improvement in brain function and symptoms following omega 3 supplementation (McNamara et al., 2016).

The results of the first step of this quasi-experiment suggest a role for physical and environmental characteristics of schools, in conjunction with dietary supplementation for some children, that affect stressed children in schools independent of various common explanations for child behaviour problems, such as socio-economic status of the children's families. As schools are part of complex systems contributing to mental health and well-being, future research should include the possibility that factors of the school environment, such as physical characteristics of classrooms, the daily schedule, and the availability of water and food may contribute to child behaviour problems. These environmental characteristics may also affect the effectiveness of educational, psychological and behavioural interventions. As diasters may have biological impacts, it is logical that interventions must address child health and well-being.

Ana V. Diez Roux (2017), of the Urban Health Collaborative, Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania writes that a range of sources of evidence, including observational studies and quasi-experiments, "will be necessary to build a compelling story. A single type of evidence will never be enough. The problems with which we are grappling are too complex for that. The more complex, and I would argue, the more socially relevant the problem, the more likely that the causal story can only be derived by putting together multiple sources of information, thinking systemically, acting on the system, and then learning from that action not only about what interventions work but also about causes more fundamentally." The present study may have initiated and contributed to a conversation that interventions that address biological attributes of PTSD may produce improved psychosocial outcomes, and should be considered for disaster-affected communities in which clinicians are in short supply.

Resilience and vulnerability to stress are intricately associated with the autonomic nervous system and brain functions (Franklin, Saab & Mansuy, 2012), although the tendency is to focus on mentation and psychological functions. As stated most eloquently by Joe Boden and colleagues (2016), in reference to a study of positive outcomes in youth transitioning to adulthood, "Rather than a static, individual trait, resilience becomes a set of resources that are able to be enhanced by the actions of others, such as the professionals and caregiving adults who are involved in the lives of vulnerable children, and in this way the impact of risks on later outcomes can be modified." As indicated by this quasi-experiment, principals, teachers and parents can trial relatively simple changes to school environments that may act as a resource to improve children's resilience to stress.

References

Abramson, D. M., Park, Y. S., Stehling-Ariza, T., & Redlener, I. (2010). Children as bellwethers of recovery: dysfunctional systems and the effects of parents, households, and neighborhoods on serious emotional disturbance in children after Hurricane Katrina. *Disaster Medicine and Public Health Preparedness*, *4*(S1), S17-S27. p. S17.

Achenbach, T. M., & Ruffle, T. M. (2000). The Child Behavior Checklist and related forms for assessing behavioral/emotional problems and competencies. *Pediatrics in Review, 21(*8), 265-271

Achenbach, T., & Rescorla, L. (2001). *Manual for ASEBA school-age forms and profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.

Adolphus, K., Lawton, C. L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Frontiers in Human Neuroscience*, *7*, 425

Aghajani, M., Klapwijk, E., van der Wee, No, Veer, I, Rombouts, S., Boon, A., van Beelen, P., Popma, A, Vermeiren, R. & Collins, O. (2017). Disorganized amygdala networks in conduct-disordered juvenile offenders with callous-unemotional traits. *Biological Psychiatry, 82* (4), 283-293.

Agorastos, A. (2017). Pathophysiological trajectories and biological consequences of early life trauma. *European Journal of Psychotraumatology*, *8*(sup4), 1351159.

Adolphus, K., Lawton, C. L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Frontiers in Human Neuroscience*, *7*. http://gr2tq4rz9x.scholar.serialssolutions.com/?sid=google&auinit=K&aulast=Adolphus&atitle=The+effects+of+breakfast+on+behavior+and+academic+performance+in+children+and+adolescents&id=pmid:23964220

Alisic, E., Jongmans, M., van Wesel, F. & Kleber, R. (2011). Building child trauma theory from longitudinal studies: A meta-analysis. *Clin Psychol Review, 31*, 736-747.

Alisic, E., Zalta, A. K., van Wesel, F., Larsen, S. E., Hafstad, G. S., Hassanpour, K., & Smid, G. E. (2014). Rates of post-traumatic stress disorder in trauma-exposed children and adolescents: meta-analysis. *The British Journal of Psychiatry, 204(*5), 335-340. (inc. Supplemental Tables).

Angelillo, I. F., Di Maio, G., Costa, G. & Barillari, U. (2015). Prevalence of occupational voice disorders in teachers. *Journal of Preventive Medicine and Hygiene*, *50*(1), 26-32.

Aylward, E. H., Richards, T. L., Berninger, V. W., Nagy, W. E., Field, K. M., Grimme, A. C., Richards, A., Thomson, J. & Cramer, S. C. (2003). Instructional treatment associated with changes in brain activation in children with dyslexia. *Neurology*, *61*(2), 212-219.

American Academy of Child and Adolescent Psychiatry (AACAP) (2010), Official Action: Practice parameter for the assessment and treatment of children and adolescents with posttraumatic stress disorder. *J. Am. Acad. Child. Adolesc. Psychiatry, 49*(4), 414-430.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Pub.

Andersen, S. L., Tomada, A., Vincow, E. S., Valente, E., Polcari, A., & Teicher, M. H. (2008). Preliminary evidence for sensitive periods in the effect of childhood sexual abuse on regional brain development. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *20*(3), 292-301.

Angelillo, I. F., Di Maio, G., Costa, G., & Barillari, U. (2015). Prevalence of occupational voice disorders in teachers. *Journal of Preventive Medicine and Hygiene*, *50*(1), 26-32.

Arnold, L. E., Hurt, E., & Lofthouse, N. (2013). Attention-deficit/hyperactivity disorder: dietary and nutritional treatments. *Child and Adolescent Psychiatric Clinics of North America*, *22*(3), 381-402.

Asarnow, J., Glynn, S., Pynoos, R., Nahum, J., Guthrie, D., Cantwell, D. & Franklin, B. (1999). When the earth stops shaking: Earthquake sequele among children diagnosed for Pre-earthquake psychopathology. *J. Am. Acad. Child Adolesc. Psychiatry, 38* (8), 1016-1023.

Ashmore, T. (2013). The implementation of trauma-informed care in acute mental health impatient units: A comparative study. New Zealand: Massey University. https://mro.massey.ac.nz/handle/10179/5855

Australian Childhood Foundation (2010). *Making SPACE for Learning: Trauma Informed Practice in Schools.* https://www.theactgroup.com.au/documents/makingspaceforlearning-traumainschools.pdf.

Atkinson, J., Salmond, C., & Crampton, P. (2014). *NZDep2013 Index of Deprivation*. Wellington: University of Otago Department of Public Health.

Babenko, O., Kovalchuk, I., & Metz, G. A. (2015). Stress-induced perinatal and transgenerational epigenetic programming of brain development and mental health. *Neuroscience & Biobehavioral Reviews*, *48*, 70-91.

Bal, A. (2008). Post-traumatic stress disorder in Turkish child and adolescent survivors three years after the Marmara Earthquake. *Child Adolescent Mental Health, 13(*3), 134-139.

Bar-David, Y. A. I. R.,Urkin, J., & Kozminsky, E. L. Y. (2005). The effect of voluntary dehydration on cognitive functions of elementary school children. *Acta Paediatrica, 94*(11), 1667-1673.

Bark, K., Stenberg, S., & Hayes, D. (2010). Scheduling Recess Before Lunch: Exploring the Benefits and Challenges in Montana Schools*. Journal of Child Nutrition and Manage*ment. 34 (2).

Bärnighausen, T., Oldenburg, C., Tugwell, P., Bommer, C., Ebert, C., Barreto, M., ... & Sianesi, B. (2017). Quasi-experimental study designs series–Paper 7: assessing the assumptions. *Journal of Clinical Epidemiology*, *89*, 53-66.

Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2015). The impact of classroom design on pupils' learning: Final results of a holistic, multi-level analysis. *Building and Environment, 89*, 118-133.

Barrett, P., Farrell, L., Ollendick, T & Dadds, M. (2006). Long-term outcome of an Australian Universal Prevention Trial of anxiety and depression symptoms in children and youth: An evaluation of The Friends program. *Journal of Clinical Child and Adolescent Psychology, 35*(3), 403-411.

Barsaglini, A., Sartori, G., Benetti, S., Pettersson-Yeo, W., & Mechelli, A. (2014). The effects of psychotherapy on brain function: A systematic and critical review. *Progress in neurobiology*, *114*, 1-14.

Baum, P., Petroff, D., Classen, J., Kiess, W., & Blüher, S. (2013). Dysfunction of autonomic nervous system in childhood obesity: a cross-sectional study. *PloS one, 8*(1), e54546.

Bell, J. F., & Zimmerman, F. J. (2010). Shortened nighttime sleep duration in early life and subsequent childhood obesity. *Archives of Pediatrics & Adolescent Medicine, 164*(9), 840-845.

Belivanaki, M., Ropi, S., Kanari, N., Tsiantis, J., & Kolaitis, G. (2017). Trauma and post-traumatic stress disorder among psychiatric inpatient children and adolescents. *European Journal of Psychotraumatology*, *8*(sup4), 1351161.

Benros, M. E. (2015). Posttraumatic stress disorder and autoimmune diseases. *Biological Psychiatry*, *77*(4), 312-313.

Benton D (2007) The impact of diet on anti-social behaviour. *Neurosci Biobehav Rev* 31:752–774.

Benton, D. (2008). The influence of children's diet on their cognition and behavior. *European Journal of Nutrition*, *47*(3), 25-37.

Benton, D., & Burgess, N. (2009). The effect of the consumption of water on the memory and attention of children. *Appetite*, *53*(1), 143-146.

Benton, D., & Jarvis, M. (2007). The role of breakfast and a mid-morning snack on the ability of children to concentrate at school. *Physiology & Behavior*, *90*(2), 382-385.

Bergland, C. (2014). *Chronic Stress Can Damage Brain Structure and Connectivity***.** https://www.psychologytoday.com/blog/the-athletes-way/201402/chronic-stress-can-damage-brain-structure-and-connectivity

Bhatt, R. (2009). The impact of school lunch length on children's health. Working paper 2009-4-2. Georgia State University: Andrew Young School.

Bhatt, R. (2014). Timing is Everything: The impact of school lunch length on children's body wei*ght. Southern Economic Journa*l, *80*(3), 656-676.

Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and psychopathology*, *20*(3), 899-911.

Blair, C., & Raver, C. C. (2012). Child development in the context of adversity: experiential canalization of brain and behavior. *American Psychologist*, *67*(4), 309.

Blodget, C. & Dorado, J. (2016). *A Selected Review of Trauma-Informed School Practice and Alignment with Educational Practice* http://ext100.wsu.edu/cafru/wp-content/uploads/sites/65/2015/02/CLEAR-Trauma-Informed-Schools-White-Paper.pdf

Blundell, S. (2014). Red Zone. New Zeakabd Geographic, *124,* https://www.nzgeo.com/stories/red-zone/

Boden, JM., Sanders, J., Munford, R., Liebenberg, L., & McLeod, G. F. (2016). Paths to positive development: A model of outcomes in the New Zealand youth transitions study. *Child Indicators Research, 9*(4), 889-911.

Bonanno, G., Brewin, C., Kaniasty K., & La Greca, A. (2010). Weighing the costs of disaster: Consequences, risks, and resilience in individuals, families and communities. *Psychological Science in the Public Interest, 11*(1), 1-49

Bonne, L. (2016). National Standards in their Seventh Year. Wellington, NZ: NZCER. http://www.nzcer.org.nz/research/publications/national-standards-their-seventh-year

Bounds, W., Nettles, M. F., & Johnson, J. T. (2009). Recess before Lunch Programs in Elementary Schools: Perceptions and Practices of School Professionals. *Journal of Child Nutrition & Manag*ement, 33(1), n1.

Bor, J. (2016). Capitalizing on natural experiments to improve our understanding of population health. *American journal of public health*, *106*(8), 1388.

Bowers, M. E., & Yehuda, R. (2016). Intergenerational transmission of stress in humans. *Neuropsychopharmacology: official publication of the American College of Neuropsychopharmacology*, *41*(1), 232-244. http://europepmc.org/articles/pmc4677138

Boyce, W. T., Adams, S., Tschann, J. M., Cohen, F., Wara, D., & Gunnar, M. R. (1995). Adrenocortical and behavioral predictors of immune responses to starting school. *Pediatric Research*, *38*(6), 1009-1017.

Boyd, J. E., Lanius, R. A., & McKinnon, M. C. (2017). Mindfulness-based treatments for posttraumatic stress disorder: a review of the treatment literature and neurobiological evidence. *Journal of Psychiatry & Neuroscience: JPN*, *42*(6), 170021.

Bradshaw, C. P., Waasdorp, T. E., & Leaf, P. J. (2012). Effects of school-wide positive behavioral interventions and supports on child behavior problems. *Pediatrics*, *130*(5), e1136-e1145.

Breslau, N. (2009). The epidemiology of trauma, PTSD, and other posttrauma disorders. *Trauma, Violence & Abuse*, *10* (3), 198–210. doi:10.1177/1524838009334448

Brooker, A., & Franklin, A. (2016). The effect of colour on children's cognitive performance. *British Journal of Educational Psychology, 86(*2), 241-255.

Brown, R. C., Witt, A., Fegert, J. M., Keller, F., Rassenhofer, M., & Plener, P. L. (2017). Psychosocial interventions for children and adolescents after man-made and natural disasters: a meta-analysis and systematic review. *Psychological Medicine*, *47*(11), 1893-1905.

Bruce, J., Davis, E. P., & Gunnar, M. R. (2002). Individual differences in children's cortisol response to the beginning of a new school year. *Psychoneuroendocrinology*, *27*(6), 635-650.

Bryant, R. A., O'Donnell, M. L., Creamer, M., McFarlane, A. C., & Silove, D. (2011). Posttraumatic intrusive symptoms across psychiatric disorders. *Journal of Psychiatric Research*, *45*(6), 842-847.

Buchhorn, R., Koenig, J., Jarczok, M.N. et al. (2017). A case series on the potential effect of omega-3-fatty acid supplementation on 24-h heart rate variability and its circadian variation in children with attention deficit (hyperactivity) disorder. *ADHD Atten Def Hyp Disord* , 1-5.

Bücker, J., Kapczinski, F., Post, R., Ceresér, K. M., Szobot, C., Yatham, L. N., ... & Kauer-Sant'Anna, M. (2012). Cognitive impairment in school-aged children with early trauma. *Comprehensive Psychiatry*, *53*(6), 758-764.

Bulut, S., Bulut, S., & Tayli, A. (2005). The dose of exposure and prevalence rates of post traumatic stress disorder in a sample of Turkish children eleven months after the 1999 Marmara earthquakes. *School Psychology International*, *26*(1), 55-70.

Burgess, J. R., Stevens, L., Zhang, W., & Peck, L. (2000). Long-chain polyunsaturated fatty acids in children with attention-deficit hyperactivity disorder. *The American journal of clinical nutrition*, *71*(1), 327S-330S.

Bush, N. R., Obradović, J., Adler, N., & Boyce, W. T. (2011). Kindergarten stressors and cumulative adrenocortical activation: The “first straws” of allostatic load?. *Development and Psychopathology*, *23*(4), 1089-1106.

Byrd, R. S., Weitzman, M., & Auinger, P. (1997). Increased behavior problems associated with delayed school entry and delayed school progress. *Pediatrics*, *100*(4), 654-661.

Cacciaglia, R., Nees, F., Grimm, O., Ridder, S., Pohlack, S. T., Diener, S. J., ... & Flor, H. (2017). Trauma exposure relates to heightened stress, altered amygdala morphology and deficient extinction learning: Implications for psychopathology. *Psychoneuroendocrinology*, *76*, 19-28.

Cai, D., Zhu, Z., Sun, H., Qi, Y., Xing, L., Zhao, X., ... & Li, H. (2017). Maternal PTSD following exposure to the Wenchuan earthquake is associated with impaired mental development of children. *PLoS one*, *12*(4), e0168747.

Calder, K., D’Aeth, L., Turner, S., Fox, C., & Begg, A. (2016). Evaluation of a well-being campaign following a natural disaster in Christchurch, New Zealand. *International Journal of Mental Health Promotion*, *18*(4), 222-233.

Canterbury Earthquake Recovery Authority (CERA).(2012). Land Classifications.

Canterbury Earthquake Recovery Authority (CERA). (2013). *Wellbeing Survey September 2012*. Wellington: CERA

Canterbury Earthquake Recovery Authority (CERA). (2014). *Wellbeing Survey September 2013*. Wellington: CERA

Canterbury Earthquake Recovery Authority (CERA). (2015). *Wellbeing Survey September 2014*. Wellington: CERA

Carley, A. (2017). The effect of micronutrient therapy on teachers with insomnia. Masters Thesis, University of Canterbury. Christchurch, New Zealand.

Carmassi, C., Bertelloni, C. A., Massimetti, G., Miniati, M., Stratta, P., Rossi, A., & Dell, L. (2015). Impact of DSM-5 PTSD and gender on impaired eating behaviors in 512 Italian earthquake survivors. *Psychiatry research*, *225*(1), 64-69.

Carotenuto, M., Esposito, M., Cortese, S., Laino, D., & Verrotti, A. (2016). Children with developmental dyslexia showed greater sleep disturbances than controls, including problems initiating and maintaining sleep. *Acta Paediatrica*, *105*(9), 1079-1082.

Carr, V. J., Lewin, T. J., Webster, R. A., Kenardy, J. A., Hazell, P. L., & Carter, G. L. (1997). Psychosocial sequelae of the 1989 Newcastle earthquake: II. Exposure and morbidity profiles during the first 2 years post-disaster. *Psychological Medicine*, *27*(01), 167-178.

Carrion, V. G., Weems, C. F., & Bradley, T. (2010). Natural disasters and the neurodevelopmental response to trauma in childhood: A brief overview and call to action. *Future Neurology*, *5*(5), 667-674.

Carrion, V. G., Weems, C. F., & Reiss, A. L. (2007). Stress predicts brain changes in children: a pilot longitudinal study on youth stress, posttraumatic stress disorder, and the hippocampus. *Pediatrics*, *119*(3), 509-516.

Cartwright□Hatton, S., Roberts, C., Chitsabesan, P., Fothergill, C., & Harrington, R. (2004). Systematic review of the efficacy of cognitive behaviour therapies for childhood and adolescent anxiety disorders. *British journal of clinical psychology*, *43*(4), 421-436.

Carville, O. (2016, 18 April.). Forgotten victims: The hidden toll of the Christchurch earthquakes. *The New Zealand Herald*. http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11622371

Carville, O. (2017, 26 July). Break the silience: Self-harm epidemic ‘elephant in the room’. *The New Zealand Herald*. http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11894602

Celsi, R., Wolfinbarger, M., & Wald, D. (2005). The effects of earthquake measurement concepts and magnitude anchoring on individuals’ perceptions of earthquake risk. *Earthquake Spectra*, *21*(4), 987-1008.

Chang, S. E., Taylor, J. E., Elwood, K. J., Seville, E., Brunsdon, D., & Gartner, M. (2014). Urban disaster recovery in Christchurch: the central business district cordon and other critical decisions. *Earthquake Spectra*, *30*(1), 513-532.

Chapman, K & Moir, J. (2013, June 1).Is free breakfast in schools working? Wellington: *The Dominion Post* http://www.stuff.co.nz/dominion-post/news/8744856/Is-free-breakfast-in-schools-working

Chemtob, C. M., Nomura, Y., Rajendran, K., Yehuda, R., Schwartz, D., & Abramovitz, R. (2010). Impact of maternal posttraumatic stress disorder and depression following exposure to the September 11 attacks on preschool children's behavior. *Child Development*, *81*(4), 1129-1141.

Chen, E., & Miller, G. E. (2012). "Shift-and-persist" strategies: Why low socioeconomic status isn't always bad for health. *Perspectives on Psychological Science*, *7*(2), 135-158.

Chu, A. T., & Lieberman, A. F. (2010). Clinical implications of traumatic stress from birth to age five. *Annual Review of Clinical Psychology*, *6*, 469-494.

Christchurch Press (17 Feb 2017). Christchurch Port Hills fire: Cordons lift, more than 1400 fire evacuees able to return to check their homes. http://www.stuff.co.nz/national/89508065/christchurch-port-hills-fire-hope-the-corner-is-turned-over-blazes

Chrousos, G. P. (2009). Stress and disorders of the stress system. *Nature Reviews Endocrinology*, *5*(7), 374-381.

Clay, H, & Bobier, C. (2012, April). *The Child and Adolescent Mental Health Service Response to the Christchurch Earthquakes:* Have we recovered yet? Paper presented at Earth, fire and rain: Australian & New Zealand Disaster and Emergency Management Conference, Brisbane: Australia.

Cloitre, M., Stolbach, B. C., Herman, J. L., Kolk, B. V. D., Pynoos, R., Wang, J., & Petkova, E. (2009). A developmental approach to complex PTSD: Childhood and adult cumulative trauma as predictors of symptom complexity. *Journal of Traumatic Stress, 22(*5), 399-408.

Cobham, V. E., McDermott, B., Haslam, D., & Sanders, M. R. (2016). The role of parents, parenting and the family environment in children's post-disaster mental health. *Current psychiatry reports*, *18*(6), 53-62.

Cohen, J. A., Issues, T. W. G. O. Q., & AACAP Work Group on Quality Issues. (2010). Practice parameter for the assessment and treatment of children and adolescents with posttraumatic stress disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*(4), 414-430.

Compas, B.E., Connor-Smith, J. K., Saltzman, H., Thomsen, A. H., Wadsworth, M. (2001). Coping with stress during childhood and adolescence: Progress, problems, and potential. *Psychological Bulletin*, *127*, 87–127.

Compas, B. E., Jaser, S. S., Dunbar, J. P., Watson, K. H., Bettis, A. H., Gruhn, M. A., & Williams, E. K. (2014). Coping and emotion regulation from childhood to early adulthood: Points of convergence and divergence. *Australian Journal of Psychology*, *66*(2), 71–81. http://doi.org/10.1111/ajpy.12043

Cook, B. G., & Odom, S. L. (2013). Evidence-based practices and implementation science in special education. *Exceptional Children*, *79*(2), 135-144.

Cook-Cottone, C. (2004). Childhood posttraumatic stress disorder: Diagnosis, treatment, and school reintegration. *School Psychology Review*, *33*(1), 127-139.

Connor, D. F., Ford, J. D., Arnsten, A. F., & Greene, C. A. (2014). An update on Posttraumatic Stress Disorder in children and adolescents. *Clinical Pediatrics,* 0009922814540793

Contractor, A. A., Layne, C. M., Steinberg, A. M., Ostrowski, S. A., Ford, J. D., & Elhai, J. D. (2013). Do gender and age moderate the symptom structure of PTSD? Findings from a national clinical sample of children and adolescents. *Psychiatry Research*, *210*(3), 1056-1064.

Conway, G. (07.02.2014). *Plan to relieve quake stress*. Stuff. http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/9696083/Plan-to-relieve-quake-stress.

Cook B. G., Odom S. L. (2013). Evidence-based practices and implementation science in special education. *Exceptional Children, 79,* 135–144.

Coogan, A.N. & McGowan, N.M. (2017). A systematic review of circadian function, chronotype and chronotherapy in attention deficit hyperactivity disorder. *ADHD Atten Def Hyp Disord* , *9* (3), 129-147.

Cowles, M., & Davis, J. (2017). Identifying, assessing and treating complicated post-traumatic stress disorder in adolescence: a single-case quasi-experimental design with clinical case report. *the Cognitive Behaviour Therapist*, *10*.

Creamer, M., Bell, R. & Failla, S. (2003). Psychometric properties of the Impact of Event Scale-Revised. *Behaviour Research and Therapy, 41*(12), 1489-1496.

Crocq, L. (2002). Special teams for medical/psychological intervention in disaster victims. *World Psychiatry*, *1*(3), 154-155.

Crooks, C. V., Scott, K. L., Wolfe, D. A., Chiodo, D., & Killip, S. (2007). Understanding the link between childhood maltreatment and violent delinquency: What do schools have to add?. *Child Maltreatment*, *12*(3), 269-280.

Crowe, C. (2013). *Canterbury Quake Live*: GeoNet Search engine for quakes. http://www.canterburyquakelive.co.nz/QuakeSearch.

Cubrinovski, M., Hughes, M., Bradley, B., McCahon, I., McDonald, Y, Simpson, H., Cameron, R., Christison, M., Henderson, B., Orense, R. & O'Rourke, T. (2011). *Liquefaction impacts on pipe networks*. Research Report 2011-04. University of Canterbury: Civil and Natural Resources Engineering. ISSN 1172-9511.

Cubrinovski, M., Robinson, K., Taylor, M., Hughes, M., & Orense, R. (2012). Lateral spreading and its impacts in urban areas in the 2010–2011 Christchurch earthquakes. *New Zealand Journal of Geology and Geophysics, 55*(3), 255-269.

Currie, J., Stabile, M., & Jones, L. (2014). Do stimulant medications improve educational and behavioral outcomes for children with ADHD?. *Journal of health economics*, *37*, 58-69.

Cuttance, P. (2003). Quality assurance for schools. In T. Townsend (Ed.) *Restructuring and Quality: Issues for tomorrow's schools*, 100-113. London: Routledge. 1134785658

Cutuli, J. J., Wiik, K. L., Herbers, J. E., Gunnar, M. R., & Masten, A. S. (2010). Cortisol function among early school-aged homeless children. *Psychoneuroendocrinology*, *35*(6), 833-845.

Daily Mail Reporter (6.09.2010). *Earth's surface 'lurches 11 ft. to the right' as New Zealand earthquake rips new fault line.* http://www.dailymail.co.uk/news/article-1309194/New-Zealand-earthquake-moves-Earths-surface-11ft-right.html#comments

Dallman, M. F. (2010). Stress-induced obesity and the emotional nervous system. *Trends in Endocrinology & Metabolism*, *21*(3), 159-165.

Dancause, K. N., Laplante, D. P., Fraser, S., Brunet, A., Ciampi, A., Schmitz, N., & King, S. (2012). Prenatal exposure to a natural disaster increases risk for obesity in 5 [frac12]-year-old children. P*ediatric Research, 7*1(1), 126-131.

Dancause, K. N., Laplante, D. P., Oremus, C., Fraser, S., Brunet, A., & King, S. (2011). Disaster-related prenatal maternal stress influences birth outcomes: Project Ice Storm. *Early Human Development, 87*(12), 813-820.

Dancause, K. N., Veru, F., Andersen, R. E., Laplante, D. P., & King, S. (2013). Prenatal stress due to a natural disaster predicts insulin secretion in adolescence. *Early Human Development, 89*(9), 773-776.

D'Anci, K. E., Constant, F., & Rosenberg, I. H. (2006). Hydration and cognitive function in children. *Nutrition Reviews*, *64*(10), 457-464.

Darmody, M., & Smyth, E. (2016). Primary school principals' job satisfaction and occupational stress. *International Journal of Educational Management, 30*(1), 115-128.

Daud, A. & Rydelius, P-A. (2009). Comorbidity/Overlapping between ADHD and PTSD in relation to IQ among children of traumatized/non-traumatized parents. *Journal of Attention Disorders, 13,* 188-

Davey, B., Alexander, M., Edmonson, C., Stenhoff, D., & West, R. P. (2001). The Effects of a Discriminative Stimulus, Paired with Individual and Group Reward Contingencies, on the Decibel Levels in an Elementary School Lunch Room. ERIC http://files.eric.ed.gov/fulltext/ED453023.pdf

Davidson, R. J., & McEwen, B. S. (2012). Social influences on neuroplasticity: stress and interventions to promote well-being. *Nature Neuroscience*, *15*(5), 689-695. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3491815/

Davidson, J. R., & McFarlane, A. C. (2006). The extent and impact of mental health problems after disaster. *J Clin Psychiatry*, *67*(suppl 2), 9-14.

Dawson, G., Jones, E. J., Merkle, K., Venema, K., Lowy, R., Faja, S., Kamara, D., Murias, M., Greenson,J., winte, J. Smith, M., Rogers, S., & Webb, S.(2012). Early behavioral intervention is associated with normalized brain activity in young children with autism. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(11), 1150-1159.

De Bellis, M. & Zisk, A. (2014). The biological effects of childhood trauma. *Child and Adolescent Psychiatric Clinics of North America, 23* (2), 185-222).

De Bruin-Hordijk, T. & de Groot, E. (2010). Lighting in Schools. International Energy Agency, Annex 45. (http://lightinglab.fi/IEAAnnex45/publications/Technical_reports/lighting_in_schools.pdf),

de Dear, R., Kim, J., Candido, C., & Deuble, M. (2015). Adaptive thermal comfort in Australian school classrooms. *Building Research & Information*, *43*(3), 383-398.

Dehon, C., & Scheeringa, M. S. (2006). Screening for preschool posttraumatic stress disorder with the Child Behavior Checklist. *Journal of Pediatric Psychology, 31(*4), 431-435.

Delamater, A. M., & Applegate, E. B. (1999). Child development and post-traumatic stress disorder after hurricane exposure. *Traumatology*, *5*(3), 4.

Del Gidudice, M., Hinnant, J., Ellis, B. & El-Sheikh, M. (2012). Adaptive patterns of stress responsivity: A preliminary investigation. *Developmental Psychology, 48(*3), 775-790.

De Young, A., Kenardy, J., Cobham, V. (2011). Trauma in early childhood: A neglected population. *Clinical Child and Family Psychological Review,* 14, 231-250

Delamater, A. & Applegate, E. (1999). Child development and post-traumatic stress disorder after hurricane exposure. *Traumatology, 5*(3), 20-27.

Department of Education (2010). *Behaviour and Discipline in Schools.* Memorandum submitted to Commons Select Committee on Education in the UK Parliament. https://www.publications.parliament.uk/pa/cm201011/cmselect/cmeduc/writev/behaviour/we39.htm

Department of the Interior (2016). *The water in you*. The USGS Water Science School. Department of the Interior, Washington, D.C. https://water.usgs.gov/edu/propertyyou.html

Dieleman, G. C., Huizink, A. C., Tulen, J. H., Utens, E. M., Creemers, H. E., van der Ende, J., & Verhulst, F. C. (2015). Alterations in HPA-axis and autonomic nervous system functioning in childhood anxiety disorders point to a chronic stress hypothesis. *Psychoneuroendocrinology*, *51*, 135-150.

Diez Roux, A. V. (2017). Invited Commentary: Beyond Individuals—Area Poverty and Health, or the Search for an Impactful Epidemiology. *American Journal of Epidemiology*, *185*(11), 1171-1173.

Dogan-Ates, A. (2010). Developmental differences in children's and adolescent's post-disaster reactions. *Issues in Mental Health Nursing, 31*, 470-476.

Drexler, S. M., & Wolf, O. T. (2017). Stress and Memory Consolidation. In *Cognitive Neuroscience of Memory Consolidation* (pp. 285-300). Springer International Publishing.

Drury, S. S., Scheeringa, M. S., & Zeanah, C. H. (2008). The traumatic impact of Hurricane Katrina on children in New Orleans. *Child and adolescent psychiatric clinics of North America*, *17*(3), 685-702.

Dube, S. R., Anda, R. F., Felitti, V. J., Chapman, D. P., Williamson, D. F., & Giles, W. H. (2001). Childhood abuse, household dysfunction, and the risk of attempted suicide throughout the life span: findings from the Adverse Childhood Experiences Study. *Journal of the American Medical Association, 286*(24), 3089-3096.

Duncan, J. S., Schofield, G., Duncan, E. K., & Rush, E. C. (2008). Risk factors for excess body fatness in New Zealand children. *Asia Pacific Journal of Clinical Nutrition*, *17*(1), 138-147.

Dugan, E. M., Snow, M. S., & Crowe, S. R. (2010). Working with children affected by Hurricane Katrina: two case studies in play therapy. *Child and Adolescent Mental Health, 15*(1), 52-55.

Dunn, L. & Dunn, D. (2007). P*eabody Picture Vocabulary Test, Fourth Edition.* Pearson.

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta□analysis of school□based universal interventions. *Child Development*, *82*(1), 405-432.

Durie, M. (1994). *Whaiora: Māori Health Development*. Auckland: Oxford University Press.

Education Counts (2017). National Standards by Region (Canterbury). https://www.educationcounts.govt.nz/know-your-region/region/national-standards/mathematics?district=&region=13; https://www.educationcounts.govt.nz/know-your-region/region/national-standards/writing?district=&region=13; https://www.educationcounts.govt.nz/know-your-region/region/national-standards/reading?district=&region=13

Education Counts (2017). 2013-2016 Achievement Information. Wellington: Ministry of Education. http://www.educationcounts.govt.nz/statistics/schooling/national-standards/National_Standards; https://www.educationcounts.govt.nz/statistics/schooling/national-standards/National_Standards

Edmonds, C. J., & Jeffes, B. (2009). Does having a drink help you think? 6–7-Year-old children show improvements in cognitive performance from baseline to test after having a drink of water. *Appetite*, *53*(3), 469-472.

Eksi, A. & Braun, K. L. (2009). Over-time changes in PTSD and depression among children surviving the 1999 Istanbul earthquake. *Eur Child Adolesc Psychiatry, 18,* 384-391.

Ekşi, A., Braun, K. L., Ertem-Vehid, H., Peykerli, G., Saydam, R., Toparlak, D., & Alyanak, B. (2007). Risk factors for the development of PTSD and depression among child and adolescent victims following a 7.4 magnitude earthquake. *International Journal of Psychiatry in Clinical Practice*, *11*(3), 190-199.

Elliot, A. J., & Maier, M. A. (2012). Color-in-context theory. *Advances in experimental social psychology, 45*, 61-125.

Ellis, B. H., & Alisic, E. (2013). Maternal emotion coaching: A protective factor for traumatized children's emotion regulation?. *Journal of Child & Adolescent Trauma*, *6*(2), 118-125.

Elzinga, B. & Bremner, J. (2002). Are substrates of memory the final common pathway in posstraumatic stress disorder? *Journal of Affective Disorders, 70*, 1-17.

Endo, T., Shioiri, T., Toyabe, S., Akazawa, K., & Someya, T. (2007). Parental mental health affects behavioral changes in children following a devastating disaster: A community survey after the 2004 Niigata-Chuetsu earthquake. *General Hospital Psychiatry, 29(*2), 175-176.

Enlow, M. B., Blood, E., & Egeland, B. (2013). Sociodemographic risk, developmental competence, and PTSD symptoms in young children exposed to interpersonal trauma in early life. *Journal of Traumatic Stress*, *26*(6), 686-694.

Epps, S. R., Park, S. E., Huston, A. C., & Ripke, M. (2003, March). *Psychometric analyses of the Positive Behavior Scale in the New Hope project and the Panel Study of Income Dynamics*. In Child Trends Conference on Positive Outcomes. Washington, DC. Available from: hildtrends.org/wp-content/uploads/2013/05/Child_Trends-2003_03_12_PD_PDConfEPRH.pdf

Epps, S. R., Park, S. E., Huston, A. C., & Ripke, M. (2005). A scale of positive social behaviors. In K. Moore & L. Lippman (Eds.) *What Do Children Need to Flourish? Conceptualizing and Measuring Indicators of Positive Development*, 163-179. The Search Institute: Springer Publishing.

Evans, L. G., & Oehler-Stinnett, J. (2006). Structure and prevalence of PTSD symptomology in children who have experienced a severe tornado. *Psychology in the Schools*, *43*(3), 283-295. [loss of hope and fear of a foreshortened future. Primary school age.

Fadda, R., Rapinett, G., Grathwohl, D., Parisi, M., Fanari, R., Calò, C. M., & Schmitt, J. (2012). Effects of drinking supplementary water at school on cognitive performance in children. *Appetite*, *59*(3), 730-737.

Fan, F., Zhang, Y., Yang, Y., Mo, L. and Liu, X. (2011), Symptoms of posttraumatic stress disorder, depression, and anxiety among adolescents following the 2008 Wenchuan earthquake in China. *J. Traum. Stress, 24*, 44–53.

Fan, F., Zhou, Y., Mo, L., Zhang, W., Xie, J., Liu, X., & WEAHC Study Group. (2016). Cohort profile: the Wenchuan earthquake adolescent health cohort study. *International Journal of Epidemiology*, *46*(1), 27-28.

Fairbank, J. A., & Fairbank, D. W. (2009). Epidemiology of child traumatic stress. *Current Psychiatry Reports, 11*(4), 289-295.

Farrow, T. F., Hunter, M. D., Wilkinson, I. D., Gouneea, C., Fawbert, D., Smith, R., .Lee, K-H., Mason, S., Spence, S. & Woodruff, P. W. (2005). Quantifiable change in functional brain response to empathic and forgivability judgments with resolution of posttraumatic stress disorder. *Psychiatry Research: Neuroimaging*, *140*(1), 45-53.

Fatima, Y., & Mamun, A. A. (2015). Longitudinal impact of sleep on overweight and obesity in children and adolescents: a systematic review and bias-adjusted meta-analysis. *Obesity Reviews, 16*(2), 137-149.

Felitti, V. J. (2009). Adverse childhood experiences and adult health. *Academic Pediatrics*, *9*(3), 131.

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., ... & Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine*, *14*(4), 245-258.

Feo, P., Di Gioia, S., Carloni, E., Vitiello, B., Tozzi, A. E., & Vicari, S. (2014). Prevalence of psychiatric symptoms in children and adolescents one year after the 2009 L'Aquila earthquake. *BMC Psychiatry*, *14*, 270-270.Ferguson, K., Frost, L., & Hall, D. (2012). Predicting teacher anxiety, depression, and job satisfaction. *Journal of Teaching andLlearning, 8*(1), 27-42.

Fergusson, D. M., & Boden, J. M. (2014). The psychological impacts of major disasters. *Australian and New Zealand Journal of Psychiatry, 48*(7), 597-599.

Fergusson, D. M., Horwood, L. J., Boden, J. M., & Mulder, R. T. (2014). Impact of a major disaster on the mental health of a well-studied cohort. *JAMA Psychiatry, 71*(9), 1025-1031.

Ferrris, E. & Petz, D. (2012). *The year that shook the rich: A review of natural disasters in 2011.* London: The Brookings Institution London School of Economics. Available form: http://www.brookings.edu/research/reports/2012/03/natural-disaster-review-ferris

Fisher, A. V., Godwin, K. E., & Seltman, H. (2014). Visual environment, attention allocation, and learning in young children when too much of a good thing may be bad. *Psychological Science, 25(*7), 1362-1370.

Flett, R. A., Kazantzis, N., Long, N. R., MacDonald, C., & Millar, M. (2002). Traumatic events and physical health in a New Zealand community sample. *Journal of Traumatic Stress*, *15*(4), 303-312.

Flook, L., Goldberg, S. B., Pinger, L., Bonus, K., & Davidson, R. J. (2013). Mindfulness for teachers: A pilot study to assess effects on stress, burnout, and teaching efficacy. *Mind, Brain, and Education*, *7*(3), 182-195.

Foa, E. B., Stein, D. J., & McFarlane, A. C. (2006). Symptomatology and psychopathology of mental health problems after disaster. *J Clin Psychiatry*, *67* (Suppl 2), 15-25.

Fok, C. C. T., Allen, J., Henry, D., & People Awakening Team. (2014). The Brief Family Relationship Scale: A brief measure of the relationship dimension in family functioning. *Assessment, 21*, 67–72.

Fonterra (2017). Milk for Schools. https://www.fonterramilkforschools.com/

Forman-Hoffman, V., Knauer, S., McKeeman, J., Zolotor, A. Blanco, R., Lloyd, S., Tant, E. & Viswanathan, M. (2013). Child and adolescent exposure to trauma: Comparative effectiveness of interventions addressing trauma other than maltreatment or family violence. *Comparative Effectiveness Review Number 107,* (Prepared by the RTI International-University of North Carolina at Chapel Hill Evidence-based Practice Center under Contract No. 290-2007-10056-I.) AHRQ Publication No. 13-EHC054-EF. Rockville, MD: Agency for Healthcare Research and Quality. Feb 2013. www.effectivehealthcare.ahrq.gov/reports/final.cfm.

Fothergill, A., & Peek, L. (2006). Surviving catastrophe: A study of children in Hurricane Katrina. *Learning from catastrophe: Quick response research in the wake of Hurricane Katrina*, 97-129. https://pdfs.semanticscholar.org/e8af/11dea971d9357b1129a8f1f154a2c6e76c02.pdf

Franklin, T. B., Saab, B. J., & Mansuy, I. M. (2012). Neural mechanisms of stress resilience and vulnerability. *Neuron*, *75*(5), 747-761.

Franks, R. (2013). Building a trauma-informed system of care for children in Connecticut. Connecticut Center for Effective Practice : Child Health and Development Institute http://www.governor.ct.gov/malloy/lib/malloy/SHAC_Doc_2013.04.26_Franks_presentation.pdf

Freedy, J. R., Saladin, M. E., Kilpatrick, D. G., Resnick, H. S., & Saunders, B. E. (1994). Understanding acute psychological distress following natural disaster. *Journal of Traumatic Stress, 7(*2), 257-273.

Friedman-Krauss, A. H., Raver, C. C., Morris, P. A., & Jones, S. M. (2014). The role of classroom-level child behavior problems in predicting preschool teacher stress and classroom emotional climate. *Early Education and Development, 25*(4), 530-552.

Fuchs, T., Lührmann, P., Simpson, F., & Dohnke, B. (2016). Fluid intake and cognitive performance: Should schoolchildren drink during lessons?. *Journal of School Health*, *86*(6), 407-413.

Fujiwara, T., Mizuki, R., Miki, T., & Chemtob, C. (2015). Association between facial expression and PTSD symptoms among young children exposed to the Great East Japan Earthquake: a pilot study. *Frontiers in Psychology*, *6*, 1534.

Fujiwara, T. Yagi, J., Homma, H., & Mashiko, H. (2017). Symptoms of post-traumatic stress disorder among young children two years after the Great East Japan Earthquake, *Disaster Medicine and Public Health Preparedness, 11*(2), 207-215.

Fujiwara, T., Yagi, J., Homma, H., Mashiko, H., Nagao, K., Okuyama, M., ... & Children Study Team. (2017). Suicide risk among young children after the Great East Japan Earthquake: A follow-up study. *Psychiatry Research*, *253*, 318-324.

Fuller, M. K. (2011). Noisy zones of proximal development: Conversation in noisy classrooms. *Journal of Sociolinguistics*, *15*(1), 65-93

Furr, J. M., Comer, J. S., Edmunds, J. M., & Kendall, P. C. (2010). Disasters and youth: A meta-analytic examination of posttraumatic stress. *Journal of Consulting and Clinical Psychology, 78*(6), 765-780.

Gaihre, S., Semple, S., Miller, J., Fielding, S., & Turner, S. (2014). Classroom carbon dioxide concentration, school attendance, and educational attainment. *Journal of School Health*, *84*(9), 569-574.

Gajos, J. M., & Beaver, K. M. (2016). The effect of omega-3 fatty acids on aggression: A meta-analysis. *Neuroscience & Biobehavioral Reviews*, *69*, 147-158.

Galea, S., Nandi, A. & Viahov, D. (2005). The epidemiology of post-traumatic stress disorder after disasters. *Epidemiologic Reviews, 27,* 78-91 (and supplemental tables).

Gao, W., Zhu, H., Giovanello, K., Smith, J., Shen, D., Gilmore, J. & Lin, W. (2014) Brain functional networks in the developing brain using resting BOLD. In T. Papageorgiou, G. Christopoulos, & S. Smirnakis, *Advanced Brain Neuroimaging Topics in Health and Disease-Methods and Applications*. ISBN 978-953-51-1203-7. Downloaded from: http://www.intechopen.com/books/advanced-brain-neuroimagingtopics-in-health-and-disease-methods-and-applications.Open Access.

Geonet Science. *Canterbury Quakes*. Retrieved 14-06-14. from http://info.geonet.org.nz/display/home/Canterbury+Quakes

Gersten, R., & Dimino, J. (2001). The realities of translating research into classroom practice. *Learning Disabilities Research & Practice*, *16*(2), 120-130.

Getlinger M., Laughlin C., Bell, E, Akre, C, Arjmandi, B. (1996). Food waste is reduced when elementary-school children have recess before lunch. *J Am Diet Assoc, 96*, 906–90.

Gibson-Moore, H. (2013). Improving hydration in children: a sensible guide. *Nutrition Bulletin*, *38*(2), 236-242.

Gillies, D., Taylor, F., Gray, C., O'Brien, L. & D'Abrew, N. (2013). Psychological therapies for the treatment of post-traumatic stress disorder in children and adolescents (review). *Evidence-Based Child Health: A Cochrane Revuew Journal, 8(*3), 1004-1116.

Giovinazzi, S., Stevenson, J. R., Mitchell, J., & Mason, A. (2012, November). *Temporary housing issues following the 22nd Christchurch Earthquake,* NZ. In Unpublished paper presented at the 2012 NZSEE Conference. http://www. nzsee. org. nz/db/2012/Paper125. pdf. Accessed (Vol. 28).

Glasgow, R. E. & Emmons, K. M. (2007). How can we increase translation of research into practice? Types of evidence needed. *Annu. Rev. Public Health*, *28*, 413-433.

Glasgow, R. E., Klesges, L. M., Dzewaltowski, D. A., Bull, S. S., & Estabrooks, P. (2004). The future of health behavior change research: what is needed to improve translation of research into health promotion practice?. *Annals of Behavioral Medicine*, *27*(1), 3.

Glasgow, R. E., Lichtenstein, E., & Marcus, A. C. (2003). Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *American journal of public health*, *93*(8), 1261-1267.

Glover, V. (2011). Annual research review: prenatal stress and the origins of psychopathology: an evolutionary perspective. *Journal of Child Psychology and Psychiatry, 52*(4), 356-367.

Glover, V., O'Connor, T. G., & O'Donnell, K. (2010). Prenatal stress and the programming of the HPA axis. *Neuroscience & Biobehavioral Reviews, 35*(1), 17-22.

Gluckman, P. Hanson, M. , Cooper, C., & Thornburg, K. L.. (2008). Mechanisms of disease: Effect of in utero and early-life conditions on adult health and disease. *The New England Journal of Medicine, 359*(1), 61-73. doi:http://dx.doi.org/10.1056/NEJMra0708473

Goenjian, A., Pynoos, R., Steinberg, A., Najarian, L., Asarnow, J., Karayan, I., Ghurabi, M. & Fairbanks, L. (1995) Psychiatric comorbidity in children after the 1988 earthquake in Armenia. *Jour. Amer. Acad. Child & Adoles. Psychiatry, 34*, 1174-1184.

Goenjian, A., Walling, D., Steinberg, A., et al. (2005). A prospective study of posttraumatic stress and depressive reactions among treated and untreated adolescents 5 years after a catastrophic disaster. *Am J Psychaitry,162*(2), 2302-08

Golden, R. N., Gaynes, B. N., Ekstrom, R. D., Hamer, R. M., Jacobsen, F. M., Suppes, T., ... & Nemeroff, C. B. (2005). The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence. *American Journal of Psychiatry, 162*, 656–662.

Goldmann, E., & Galea, S. (2014). Mental health consequences of disasters. *Annual review of public health*, *35*, 169-183.

Gomez, C. J., & Yoshikawa, H. (2017). Earthquake effects: Estimating the relationship between exposure to the 2010 Chilean earthquake and preschool children's early cognitive and executive function skills. *Early Childhood Research Quarterly*, *38*, 127-136.

Gonzalez, A., Monson, N., Solis, D., Jaycox, L & Langley, A. (2016). Trauma exposure in elementary school children: Description of screening procedures, level of exposure, and post-traumatic stress symptoms. *School Mental Health 8*(1), 77-88.

Goodwin, R. D., Fischer, M. E., & Goldberg, J. (2007). A twin study of post–traumatic stress disorder symptoms and asthma. *American journal of respiratory and critical care medicine*, *176*(10), 983-987.

Gow, R. V., Vallee-Tourangeau, F., Crawford, M. A., Taylor, E., Ghebremeskel, K., Bueno, A. A., ... & Rubia, K. (2013). Omega-3 fatty acids are inversely related to callous and unemotional traits in adolescent boys with attention deficit hyperactivity disorder. *Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA)*, *88*(6), 411-418.

Gower, A. L., & Crick, N. R. (2011). Baseline autonomic nervous system arousal and physical and relational aggression in preschool: the moderating role of effortful control. *International Journal of Psychophysiology*, *81*(3), 142-151.

Gowin, J. (2010). Why your brain needs water. *Psychology Today.* https://www.psychologytoday.com/blog/you-illuminated/201010/why-your-brain-needs-water

Graetz, K. A., & Goliber, M. J. (2002). Designing collaborative learning places: Psychological foundations and new frontiers. *New directions for teaching and learning, (92)*, 13-22.

Graham-Bermann, S. A., & Seng, J. (2005). Violence exposure and traumatic stress symptoms as additional predictors of health problems in high-risk children. *The Journal of Pediatrics, 146*(3), 349-354.

Graham-Bermann, S. A., Howell, K., Habarth, J., Krishnan, S., Loree, A. & Bermann, E. A. (2008). Toward assessing traumatic events and stress symptoms in preschool children from low□income families. *American Journal of Orthopsychiatry, 78(*2), 220-228.

Graetz, K. A., & Goliber, M. J. (2002). Designing collaborative learning places: Psychological foundations and new frontiers. *New Directions for Teaching and Learning*, *92*, 13-22.

Graginic-Philippe, R., Dayan, J., Chokron, S., Jacquet, A. Y., & Tordjman, S. (2014). Effects of prenatal stress on fetal and child development: A critical literature review. *Neuroscience & Biobehavioral Reviews, 43*, 137-162.

Grave, J. & Blissett, J. (2004). Is cognitive behavior therapy developmentally appropriate for young children? A critical review of the evidence. *Clinical Psychology Review, 24*(4), 399-420.

Grayson, J. L., & Alvarez, H. K. (2008). School climate factors relating to teacher burnout: A mediator model. *Teaching and Teacher Education*, *24*(5), 1349-1363.

Green, B., Lindy, J., Grace, M. (et al., (1990). Buffalo Creek survivors in the second decade: Stability of stress symptoms. *Am J Orthopsychiatry, 60*, 43-54.

Greenberg, M. T., & Harris, A. R. (2012). Nurturing mindfulness in children and youth: Current state of research. *Child Development Perspectives*, *6*(2), 161-166.

Greydanus, D., Bacopoulou, F., & Tsalamanios, E. (2009). Suicide in adolescents: A worldwide preventable tragedy. *The Keio Journal of Medicine, 58*(9), 95-102.

Grider, J., Bertrand, P., & Bornstein, J. (2017). Defining roles for seerotonin in the autonomic nervous system: About this research topic. *Frontiers of Neuroscience*, journals.frontiers.org

Guha-Sapir, D. & Vos, F. (2011). Earthquakes, an epidemiological perspective on patterns and trends. In R. Spence, E. So & C. Scawthorn (Eds.) *Human Casualties in Earthquakes: Advances in Natural and Technological Hazards Research (No. 29)* 13-24. London: Springer Science+Business Media.

Guha-Sapir, D., Vos, F., Below, R & Ponserre, S. (2012). *Annual Disaster Statistical Review 2011: The numbers and trends.* Brussels: Centre for Research on the Epidemiology of Disasters. Institute of Health and Society, Universite Catholique de Louvain.

Guo, J., He, H., Qu, Z., Wang, X., & Liu, C. (2017). Post-traumatic stress disorder and depression among adult survivors 8 years after the 2008 Wenchuan earthquake in China. *Journal of Affective Disorders*, *210*, 27-34.

Gunnar, M. R., & Quevedo, K. M. (2007). Early care experiences and HPA axis regulation in children: a mechanism for later trauma vulnerability. *Progress in brain research*, *167*, 137-149.

Gunnar, M. R., & Van Dulmen, M. H. (2007). Behavior problems in postinstitutionalized internationally adopted children. *Development and Psychopathology*, *19*(01), 129-148.

Gupta, M. A. (2013). Review of somatic symptoms in post-traumatic stress disorder. *International Review of Psychiatry, 25(*1), 86-99.

Guthrie, R. M., & Bryant, R. A. (2006). Extinction learning before trauma and subsequent posttraumatic stress. *Psychosomatic Medicine*, *68*(2), 307-311.

Gutermann, J., Schwartzkopff, L., & Steil, R. (2017). Meta-analysis of the long-term treatment effects of psychological interventions in youth with PTSD symptoms. *Clinical Child and Family Psychology Review*, 1-13.

Gutteling, B. M., de Weerth, C., & Buitelaar, J. K. (2005). Prenatal stress and children's cortisol reaction to the first day of school. *Psychoneuroendocrinology*, *30*(6), 541-549.

Gutteling, B. M., de Weerth, C., Zandbelt, N., Mulder, E. J., Visser, G. H., & Buitelaar, J. K. (2006). Does maternal prenatal stress adversely affect the child’s learning and memory at age six? *Journal of Abnormal Child Psychology, 34*(6), 787-796.

Haitana, T., Pitama, S., & Rucklidge, J. (2010). Cultural biases in the Peabody Picture Vocabulary Test –III: Testing tamariki in a New Zealand sample. *New Zealand Journal of Psychology, 39*(3), 24-34.

Ham, V., Cathron, G., Winter, M., & Winter, J. (2012). Evaluative study of co-located schools established following the Christchurch Earthquake. Wellington: Ministry of Education

Hannan, S. M., & Orcutt, H. K. (2013). Emotion dysregulation as a partial mediator between reinforcement sensitivity and posttraumatic stress symptoms. *Personality and Individual Differences*, *55*(5), 574-578.

Hanson, J. L., Nacewicz, B. M., Sutterer, M. J., Cayo, A. A., Schaefer, S. M., Rudolph, K. D., ... & Davidson, R. J. (2015). Behavioral problems after early life stress: contributions of the hippocampus and amygdala. *Biological psychiatry*, *77*(4), 314-323.

Harika, R. K., Eilander, A., Alssema, M., Osendarp, S. J., & Zock, P. L. (2013). Intake of fatty acids in general populations worldwide does not meet dietary recommendations to prevent coronary heart disease: a systematic review of data from 40 countries. *Annals of Nutrition and Metabolism*, *63*(3), 229-238.

Harris, R., Cormack, D., Tobias, M., Yeh, L. C., Talamaivao, N., Minster, J., & Timutimu, R. (2012). The pervasive effects of racism: experiences of racial discrimination in New Zealand over time and associations with multiple health domains. *Social Science & Medicine*, *74*(3), 408-415.

Harvard Center on the Developing Child (2006). *Excessive Stress Disrupts the Architecture of the Developing Brain*. National Scientific Council on the Developing Child . https://developingchild.harvard.edu/resources/wp3/

Harvard Center on the Developing Child (2008). *Mental health problems in early childhood can impair learning and behaviour for life.* Working Paper 6. National Scientific Council on the Developing Child. http://www.cpeip.fsu.edu/resourcefiles/mental_health%20problems_early%20childhood.pdf

Haverinen-Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of classroom ventilation rate and temperature on students' test scores. *PloS one, 10(*8), e0136165.

Hatzinger, M., Brand, S., Perren, S., Von Wyl, A., Stadelmann, S., von Klitzing, K., & Holsboer-Trachsler, E. (2013). In pre-school children, cortisol secretion remains stable over 12 months and is related to psychological functioning and gender. *Journal of Psychiatric Research*, *47*(10), 1409-1416.

Hayward, B. (2013). Rethinking resilience: reflections on the earthquakes in Christchurch, New Zealand, 2010 and 2011. *Ecology and Society*, *18*(4).

Haverinen-Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of classroom ventilation rate and temperature on students' test scores. *PloS one*, *10*(8), e0136165.

Hazell, P. L., Tarren□Sweeney, M., Vimpani, G. V., Keatinge, D., & Callan, K. (2002). Children with disruptive behaviours 1: Service utilization. *Journal of Paediatrics and Child Health, 38(*1), 27-31.

Heim, C., & Binder, E. B. (2012). Current research trends in early life stress and depression: Review of human studies on sensitive periods, gene–environment interactions, and epigenetics. *Experimental Neurology*, *233*(1), 102-111.

Hibbeln, J. R., Ferguson, T. A., & Blasbalg, T. L. (2006). Omega-3 fatty acid deficiencies in neurodevelopment, aggression and autonomic dysregulation: opportunities for intervention. *International Review of Psychiatry*, *18*(2), 107-118.

Hirini, P., Flett, R., Long, N., & Millar, M. (2005). Frequency of traumatic events, physical and psychological health among Maori. *New Zealand Journal of Psychology*, *34*(1), 20-27.

Ho, R. T., Lai, A. H., Lo, P. H., Nan, J. K., & Pon, A. K. (2017). A strength-based arts and play support program for young survivors in post-quake China: Effects on self-efficacy, peer support, and anxiety. *The Journal of Early Adolescence*, *37*(6), 805-824.

Hodgen, E. & Wylie, C. (2005). *Stress and wellbeing among New Zealand principals: Report to the New Zealand Principals' Federation*. Wellington, NZ: New Zealand Council for Educational Research. http://www.nzpf.ac.nz/uploads/7/2/4/6/72461455/section1.pdf

Holen, S., Lervag, A., Waaktaar, T., Ystgaard, M. (2012). Exploring the associations between coping patterns for everyday stressors and mental health in young schoolchildren. *Journal of School Psychology, 50,* 167-193.

Hogg, D., Kingham, S., Wilson, T. M., Griffin, E., & Ardagh, M. (2014). Geographic variation of clinically diagnosed mood and anxiety disorders in Christchurch after the 2010/11 earthquakes. *Health & Place*, *30*, 270-278.

Hogg, D., Kingham, S., Wilson, T. M., & Ardagh, M. (2016). Spatio-temporal variation of mood and anxiety symptom treatments in Christchurch in the context of the 2010/11 Canterbury earthquake sequence. *Spatial and Spatio-temporal Epidemiology*, *19*, 91-102.

Hölzel, B. K., Carmody, J., Evans, K. C., Hoge, E. A., Dusek, J. A., Morgan, L., Pitman, R. & Lazar, S. W. (2009). Stress reduction correlates with structural changes in the amygdala. *Social Cognitive and Affective Neuroscience*, *5*(1), 11-17.

Horner, R. H., Sugai, G., Smolkowski, K., Eber, L., Nakasato, J., Todd, A. W., & Esperanza, J. (2009). A randomized, wait-list controlled effectiveness trial assessing school-wide positive behavior support in elementary schools. *Journal of Positive Behavior Interventions*, *11*(3), 133-144.

Horn, S. R., Miller-Graff, L. E., Galano, M. M., & Graham-Bermann, S. A. (2017). Posttraumatic stress disorder in children exposed to intimate partner violence: the clinical picture of physiological arousal symptoms. *Child care in practice*, *23*(1), 90-103.

Hornor, G. (2013). Posttraumatic Stress Disorder. *Journal of Pediatric Health Care, 27*(3), e29-e38.

Huang-Chih Chou, F., Tung-Ping Su, T., Ou-Yang, W. C., Chien, I. C., Lu, M. K., & Chou, P. (2003). Establishment of a disaster-related psychological screening test. *Australian and New Zealand Journal of Psychiatry*, *37*(1), 97-103.

Hudson, J. L., Rapee, R. M., Lyneham, H. J., McLellan, L. F., Wuthrich, V. M., & Schniering, C. A. (2015). Comparing outcomes for children with different anxiety disorders following cognitive behavioural therapy. *Behaviour Research and Therapy*, *72*, 30-37.

Huffhines, L., Noser, A., & Patton, S. R. (2016). The link between adverse childhood experiences and diabetes. *Current Diabetes Reports*, *16*(6), 54-63.

Hunsberger, M., McGinnis, P., Smith, J., Beamer, B. A., & O'Malley, J. (2014). Elementary school children's recess schedule and dietary intake at lunch: a community-based participatory research partnership pilot study. *BMC Public Healt*h, *14*(1), 156-170.

Huston, A. C., Duncan, G. J., Granger, R., Bos, J., McLoyd, V., Mistry, R. & Ventura, A. (2001). Work-based antipoverty programs for parents can enhance the school performance and social behavior of children. *Child Development, 72*(1), 318-336.

Imuta, K., & Scarf, D. (2014). When too much of a novel thing may be what's "bad": commentary on Fisher, Godwin, and Seltman (2014). *Frontiers in Psychology, 5,* 1444. http://doi.org/10.3389/fpsyg.2014.01444)

Ingwersen, J., Defeyter, M. A., Kennedy, D. O., Wesnes, K. A., & Scholey, A. B. (2007). A low glycaemic index breakfast cereal preferentially prevents children's cognitive performance from declining throughout the morning. *Appetite*, *49*(1), 240-244.

Institute for Enhanced Classroom Hearing. (n.d.) http://www.classroomhearing.org/acoustics.html

Institute for Social Research (2010). *The Panel Study of Income Dynamics Child Development Supplement: User Guide Supplement for CDS-1*. Available from http://psidonline.org/CDS .

Jabour, R. (2015). How to differentiate ADHD from PTSD in children: Clinicians' perspectives. Master of Social Work Clinical Research Papers, Paper 467. http://sophia.stkate.edu/msw_papers/467

Jacobs, K. W., & Hustmeyer Jr., F. E. (1974). Effects of four psychological primary colors on GSR, heart rate and respiration rate. *Perceptual and Motor Skills*, *38*(3), 763-766;

Jacobs, K. W., & Suess, J. F. (1975). Effects of four psychological primary colors on anxiety state. *Perceptual and Motor Skills*, *41*(1), 207-210.

Jansen, C., Bruce, J., Williams, A., Campbell, J., Pawson, P., Harrington, J., & Major, D. (2010). *Positive youth development in Aotearoa.* Retrieved from: http://ir.canterbury.ac.nz/bitstream/10092/6132/1/12627719_2011%20Positive%20Youth%20Development%20in%20Aotearoa.pdf

Japan Times (The). (2013, Mar 12). More than 9,500 aftershocks logged since mega-quake. https://www.japantimes.co.jp/news/2013/03/12/national/more-than-9500-aftershocks-logged-since-mega-quake/#.WeQCgIpx124

Jarrin, D. C., McGrath, J. J., & Drake, C. L. (2013). Beyond sleep duration: distinct sleep dimensions are associated with obesity in children and adolescents. *International Journal of Obesity, 37*(4), 552-558.

Jia, Z., Shi, L., Duan, G., Liu, W., Pan, X., Chen, Y., & Tian, W. (2013). Traumatic experiences and mental health consequences among child survivors of the 2008 Sichuan earthquake: a community-based follow-up study. *BMC Public Health*, *13*(1), 104.

Johnston Molloy, C., Gandy, J., Cunningham, C., & Glennon Slattery, C. (2008). An exploration of factors that influence the regular consumption of water by Irish primary school children. *Journal of Human Nutrition and Dietetics*, *21*(5), 512-515.

Joseph, N. T., Matthews, K. A., & Myers, H. F. (2014). Conceptualizing health consequences of Hurricane Katrina from the perspective of socioeconomic status decline. *Health Psychology*, *33*(2), 139-146.

Juth, V., Silver, R., Sele, D., Widyatmoko, & Tan, E. (2015). Post-disaster mental health among parent-child dyads after a major earthquake in Indonesia. *J. Abnorm. Child Psychol., 43*, 1309-1318.

Kalivas, B. C., & Kalivas, P. W. (2016). Corticostriatal circuitry in regulating diseases characterized by intrusive thinking. *Dialogues in Clinical Neuroscience*, *18*(1), 65.

Kar, N. (2009). Psychological impact of disasters on children: review of assessment and interventions. *World Journal of Pediatrics*, *5*(1), 5-11.

Karam, E. G., Friedman, M. J., Hill, E. D., Kessler, R. C., McLaughlin, K. A., Petukhova, M., Sampson, L., Shahly, V., Angermeyer, M., Bromet, E., Girolamo, G., deGraf, R., Demyttenaere, K., Ferry, F., Florescu, S., Haro, J., Yanling, H., Mint, M., Karam, A., Kawakami, N., Kovess-Masfery, V., Medina-Mora, M., Browne, M., Posada-Villa, J., Shalev, A., Stein, D., Viana, M., Zarkov, Z. & Koenen, K. C. (2013). Cumulative traumas and risk thresholds: 12-month PTSD in the World Mental Health (WMH) surveys. *Depression and Anxiety, 31*(2), 130-142.

Kazantzis, N., Flett, R. A., Long, N. R., MacDonald, C., Millar, M., & Clark, B. (2010). Traumatic events and mental health in the community: a New Zealand study. *International Journal of Social Psychiatry*, *56*(1), 35-49.

Kazdin A. E. (1977). Assessing the clinical or applied significance of behavior change through social validation. *Behavior Modification, 1*, 427–452.

Kempton, M. J., Ettinger, U., Foster, R., Williams, S. C., Calvert, G. A., Hampshire, A., ... & Smith, M. S. (2011). Dehydration affects brain structure and function in healthy adolescents. *Human Brain Mapping*, *32*(1), 71-79.

Kenney, E. L., Long, M. W., Cradock, A. L., & Gortmaker, S. L. (2015). Prevalence of inadequate hydration among US children and disparities by gender and race/ethnicity: National Health and Nutrition Examination Survey, 2009–2012. *American Journal of Public Health*, *105*(8), e113-e118

Kessler, R. C., McLaughlin, K. A., Koenen, K. C., Petukhova, M., & Hill, E. D. (2012). The importance of secondary trauma exposure for post-disaster mental disorder. *Epidemiology and Psychiatric Sciences*, *21*(01), 35-45.

Kessler, R. C., Rose, S., Koenen, K. C., Karam, E. G., Stang, P. E., Stein, D. J., ... & McLean, S. A. (2014). How well can post-traumatic stress disorder be predicted from pre-trauma risk factors? An exploratory study in the WHO World Mental Health Surveys. *World Psychiatry*, *13*(3), 265-274.

Kessler, R. C., Sonnega, A., Bromet, E., Hughes, M., & Nelson, C. B. (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry*, *52*(12), 1048-1060.

Khan, N. A., Raine, L. B., Drollette, E. S., Scudder, M. R., Cohen, N. J., Kramer, A. F., & Hillman, C. H. (2015). The relationship between total water intake and cognitive control among prepubertal children. *Annals of Nutrition and Metabolism*, *66* (Suppl. 3), 38-41.

Kilmer, R. & Gil-Rivas, V. (2010). Exploring posttraumatic growth in children impacted by Hurricane Katrina: Correlates of the phenomenon and developmental considerations. *Child Development, 81*(4), 1211-27.

Klingman, A. (1993). School-based intervention following a disaster. In C.F. Saylor (Ed.)., *Children and Disasters* (pp. 187-210). Springer US.

Kinnealey, M., Pfeiffer, B., Miller, J., Roan, C., Shoener, R. & Ellner, M. L. (2012). Effect of classroom modification on attention and engagement of students with autism or dyspraxia. *American Journal of Occupational Therapy*, *66*(5), 511-519.

Kim, J. Y., Kang, H. L., Kim, D. K., Kang, S. W., & Park, Y. K. (2017). Eating habits and food additive intakes are associated with emotional states based on EEG and HRV in healthy Korean children and adolescents. *Journal of the American College of Nutrition*, *36*(5), 1-7.

King, S., Dancause, K., Turcotte-Trembly, A-M., Veru, F. & Laplante, D. (2012). Using natural disasters to study the effects of prenatal maternal stress on child health and development. *Birth Defects Research (Part C), 96*, 273-288.

Kinney, D. K., Miller, A. M., Crowley, D. J., Huang, E., & Gerber, E. (2008). Autism prevalence following prenatal exposure to hurricanes and tropical storms in Louisiana. *Journal of Autism and Developmental Disorders, 38*(3), 481-488.

Kiliç, E. Z., Özgüven, H. D. & Sayil, I. (2003). The psychological effects of parental mental health on children experiencing disaster: The experience of Bolu earthquake in Turkey. *Family Process*, *42*(4), 485-495.

Klasen, F., Otto, C., Kriston, L., Patalay, P., Schlack, R., Ravens-Sieberer, U. & Bella Study Group. (2015). Risk and protective factors for the development of depressive symptoms in children and adolescents: results of the longitudinal BELLA study. *European Child & Adolescent Psychiatry*, *24*(6), 695-703.

Klengel, T., Pape, J., Binder, E. B & Mehta, D. (2014). The role of DNA methylation in stress-related psychiatric disorders. *Neuropharmacology*, *80*, 115-132.

Kolaitis, G. (2017). Trauma and post-traumatic stress disorder in children and adolescents. *European Journal of Psychotraumatology*, *8*(sup4), 1351198.

Kolko, D. J., & Kazdin, A. E. (1993). Emotional/behavioral problems in clinic and nonclinic children: Correspondence among child, parent and teacher reports. *Journal of Child Psychology and Psychiatry, 34*(6), 991-1006.

Koss, K. J., & Gunnar, M. R. (2017). Annual Research Review: Early adversity, the hypothalamic–pituitary–adrenocortical axis, and child psychopathology. *Journal of Child Psychology and Psychiatry*. 10.1111/jcpp.12784

Kovacs, M. (2003). *Children's Depression Inventory (CDI): Technical manual update.* North Tonawanda, NY: Mulit-Health Systems.

Kronenberg, M., Hansel, T, Brennan, A, Osofsky, H., Osofsky, J. & Lawrason, B. (2010) Children of Katrina: Lessons learned about postdisaster symptoms and recovery patterns. *Child Dev., 81*(3), 1241-1259.

Küller, R., Mikellides, B., & Janssens, J. (2009). Color, arousal, and performance — A comparison of three experiments. *Color Research & Application, 34*(2),141-152.

Kuntz, J., Naswall, K. & Bockett, A. (2013). Keep calm and carry on? An investigation of teacher burnout in a post-disaster context. *New Zealand Journal of Psychology, 42* (2), 57-68.

La Greca, A. M., Lai, B. S., Llabre, M. M., Silverman, W. K., Vernberg, E. M., & Prinstein, M. J. (2013, August). Children's postdisaster trajectories of PTS symptoms: Predicting chronic distress. In *Child & Youth Care Forum*, *42*, (4), 351-369.

La Greca, A. M. & Silverman, W. K. (2009). Treatment and prevention of posttraumatic stress reactions in children and adolescents exposed to disasters and terrorism: What is the evidence? *Child Development Perspectives, 3*, 4–10.

La Greca, A. (Ed); Silverman, Wendy K. (Ed); Vernberg, Eric M. (Ed); Roberts, Michael C. (Ed), (2002). Helping children cope with disasters and terrorism. (pp. 107-138). Washington, DC, US: American Psychological Association.

Lai, B. S., Kelley, M. L., Harrison, K. M., Thompson, J. E. & Self-Brown, S. (2015). Posttraumatic stress, anxiety, and depression symptoms among children after Hurricane Katrina: A latent profile analysis. *Journal of Child and Family Studies, 24*(5), 1262-1270.

Lambert, S., & Mark-Shadbolt, M. (2012). *Māori experiences and expressions of leadership through the Christchurch Otautahi earthquakes.* Retrieved from: http://researcharchive.lincoln.ac.nz/handle/10182/5349 124

Lambert, S., Mark-Shadbolt, M., Ataria, J., & Black, A. (2012) Indigenous resilience through urban disaster: The Māori response to the 2010 and 2011 Christchurch Ōtautahi earthquakes. In: *Proceedings of the International Indigenous Development Research Conference*, pp.234-241. http://www.academia.edu/2489921/Indigenous_resilience_through_urban_disaster.

Laor, N., Wolmer, L., Kora, M., Yucel, D., Spirman, S. & Yazgan, Y. (2002). Posttraumatic, dissociative and grief symptoms in Turkish children exposed to the 1999 earthquakes. *The Journal of Nervous and Mental Disease*, *190*(12), 824-832.

Laplante, D., Brunet, A., Schmitz, N., Ciampi, A., & King, S. (2008) Project Ice Storm: Prenatal maternal stress and cognitive and linguistic functioning in 5 ½ year old children. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*(9), 1063-1072.

Law, T. (2011, 31 May). Aggresion surfaces among school children. http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/5076152/Aggression-surfaces-among-school-children.

Law, T. (2013, 13 February) Grants for quake-affected school children. http://www.stuff.co.nz/the-press/news/schools/8297636/Grants-offered-to-quake-affected-children

Lewis, K. J., Mars, B., Lewis, G., Rice, F., Sellers, R., Thapar, A. K., Craddock, N., Collishaw, S. & Thapar, A. (2012). Do parents know best? Parent-reported vs. child-reported depression symptoms as predictors of future child mood disorder in a high-risk sample. *Journal of Affective Disorders, 141*(2), 233-236.

Liberty, K. (2014). *Post Traumatic Stress Symptoms at school entry of children affected by earthquakes during their preschool years: Differential effects by age at exposure*. Presentation to the Canterbury Earthquake Recovery Authority (CERA), November 2014.

Liberty, K. & Basu, A. (2014). *Post Traumatic Stress Symptoms at school entry of children affected by earthquakes during their preschool years*. Presentation to the World Psychiatric Association: Section on Epidemiology and Public Health Conference, Nara Japan, October 2014.

Liberty, K., Macfarlane, S., Basu, A., Gage, J. & Allan, M. (2013). *PTSD symptoms and coping in children beginning school: Preliminary findings.* Christchurch, New Zealand: Researching the Health Implications of Seismic Events (RHISE) Symposium, 22 Nov 2013. In The New Zealand Medical Journal 126(1386) http://journal.nzma.org.nz/journal/126-1386/5930/

Liberty, K., Pattemore, P., Reid, J. & Tarren-Sweeney, M. (2010). Beginning school with asthma independently predicts low achievement in a prospective cohort of children. *Chest, 138*, 1349-55.

Liberty, K., Tarren-Sweeney, M., Macfarlane, S., Basu, A., & Reid, J. (2016). Behavior problems and post-traumatic stress symptoms in children beginning school: a comparison of pre-and post-earthquake groups. *PLoS currents disasters*, *8*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5419821/

Likhtik, E., & Paz, R. (2015). Amygdala–prefrontal interactions in (mal) adaptive learning. *Trends in Neurosciences*, *38*(3), 158-166.

Liu, J.; Zhao, S.R.; Reyes, T. (2015). Neurological and epigenetic implications of nutritional deficiencies on psychopathology: Conceptualization and review of evidence. *Int. J. Mol. Sci.*, *16*, 18129-18148.

Ljubisavljevic, S. (2016). Oxidative stress and neurobiology of demyelination. *Molecular Neurobiology*, *53*(1), 744-758. http://link.springer.com/article/10.1007/s12035-014-9041-x

Loeb, J., Stettler, E. M., Gavila, T., Stein, A. & Chinitz, S. (2011). The Child Behavior Checklist PTSD scale: Screening for PTSD in young children with high exposure to trauma. *Journal of Traumatic Stress, 24*(4), 430-434.

Lowe, P. A. (2014). A closer look at the psychometric properties of the Revised Children's Manifest Anxiety Scale–Second Edition among US elementary and secondary school students. *Journal of Psychoeducational Assessment*, 0734282914528611.

Luby, J., Belden, A., Botteron, K., Marrus, N., Harms, M. P., Babb, C., ... & Barch, D. (2013). The effects of poverty on childhood brain development: the mediating effect of caregiving and stressful life events. *Journal of the American Medical Association Pediatrics*, *167*(12), 1135-1142.

Lukens, E. P., & McFarlane, W. R. (2004). Psychoeducation as evidence-based practice: Considerations for practice, research, and policy. *Brief Treatment & Crisis Intervention*, *4*(3), 247-242.

Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews Neuroscience, 10*(6), 434-445.

Lutz, P. E., & Turecki, G. (2014). DNA methylation and childhood maltreatment: from animal models to human studies. *Neuroscience*, *264*, 142-156.

Macfarlane A. & Macfarlane S. (2012) Weaving the dimensions of culture and learning: Implications for educators. In Kaur, B. (Ed.), *Understanding teaching and learning: Classroom research revisited*: 213-224. Rotterdam: Sense Publishers.

Mackey, S., Chaarani, B., Kan, K-J., Spechler, P., Orr, C. ….. The Imagen Consortium. (2017). Brain regions related to impulsivity mediate the effects of early adversity on antisocial behaviour. *Biological Psychiatry, 82* (4), 275-282.

Malhi, G. S., Bassett, D., Boyce, P., Bryant, R., Fitzgerald, P. B., Fritz, K., ... & Porter, R. (2015). Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for mood disorders. *Australian & New Zealand Journal of Psychiatry*, *49*(12), 1087-1206.

Maoz, H., Goldstein, T., Goldstein, B. I., Axelson, D. A., Fan, J., Hickey, M. B., Monk, K, Sakolaky, D, Diler, R., Brent, D., Kupfer, D, & Birmaher, B. (2014). The effects of parental mood on teports of their children's psychopathology. *Journal of the American Academy of Child & Adolescent Psychiatry*, *53*(10), 1111-1122.

Maniam, J., & Morris, M. J. (2012). The link between stress and feeding behaviour. *Neuropharmacology*, *63*(1), 97-110.

Manghani, K. (2011). Quality assurance: Importance of systems and standard operating procedures. *Perspectives in Clinical Research*, *2*(1), 34–37. http://doi.org/10.4103/2229-3485.76288

Marinova, Z., & Maercker, A. (2015). Biological correlates of complex posttraumatic stress disorder—state of research and future directions. *European Journal of Psychotraumatology*, *6* (1), 1-10.

Marr, M. & Zilio, D. (2013). No island entire of itself: Reductionism and behavior analysis. *European Journal of Behavior Analysis, 14,* 241-257.

Marriott, L., & Sim, D. (2015). Indicators of inequality for Maori and Pacific people. *Journal of New Zealand Studies*, (20), 24-50.

Marsee, M. (2008). Reactive aggression and posttraumatic stress in adolescents affected by Hurricane Katrina, *Journal of Clinical Child and Adolescent Psychology, 37*(3), 519-529.

Martin, H. (2017, 21 April). Few schools 'well placed' to support students' mental health report shows. *The Christchurch Press.* http://www.stuff.co.nz/national/education/91394883/few-schools-wellplaced-to-support-students-mental-health-issues-report-shows

Massie, A., & Watson, N. R. (2011). Impact of the Christchurch earthquakes on the electrical power system infrastructure. *Bulletin of the New Zealand Society for Earthquake Engineering, 44*(4), 425-430.

Masten, A. S. (2014). Global perspectives on resilience in children and youth. *Child Development*, *85*(1), 6-20.

Masten, A. & Narayan, A. (2012). Child development in the context of disaster, war and terrorism: Pathways of risk and resilience. *Annual Rev Psychol., 63*, 227-257.

Masten, A. S. & Osofsky, J. D. (2010). Disasters and their impact on child development: Introduction to the special section. *Child Development, 81*(4), 1029-1039.

Matsui, M., Pelle, E., Dong, K. & Pemodel, N. (2016). Biological rhythms in the skin. *International Journal of Molecular Scinece, 17* (6), 801-.

Maxwell, L. & Chmielewski, E. (2008). Environmental personalization and elementary school children's self esteem. *Journal of Environmental Psychology, 28(*2), 143-153.

Maxwell, L. E., & Evans, G. W. (2000). The effects of noise on pre-school children's pre-reading skills. *Journal of Environmental Psychology, 20*(1), 91-97.

McCarty, P. & Rollow, J. (2005). *Classroom listening environment essential to successful student achievement*. (Acoustical Design: Basis of a Sound Education). Los Angeles United School District School Planning and Management.

McClelland, T., Ismail, R., Liberty, K. & Hooper, L. (2016). *Drink to Think – Think to Drink*. School of Health Sciences, New Zealand: University of Canterbury.

McColl, G. J., & Burkle, F. M. (2012). The new normal: Twelve months of resiliency and recovery in Christchurch. *Disaster Medicine and Public Health Preparedness, 6(*01), 33-43.

McConnell, G. (2016, Oct 16). The highest rate of teen suicide in the developed world. *The Christchurch Press.* http://www.stuff.co.nz/national/health/85305366/The-highest-rate-of-teen-suicide-in-the-developed-world

McCrone, J. (01.02.2014). Quake stress hurting our young. *The Christchurch Press.* http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/9674021/Quake-stress-hurting-our-young

McDermott, B. M., & Cobham, V. E. (2012). Family functioning in the aftermath of a natural disaster. *BMC Psychiatry, 12(*1), 55-61.

McKellin, W. H., Shahin, K., Hodgson, M., Jamieson, J. & Pichora□Fuller, M. K. (2011). Noisy zones of proximal development: Conversation in noisy classrooms. *Journal of Sociolinguistics, 15*(1), 65-93.

McLaughlin, K. A., Koenen, K. C., Friedman, M. J., Ruscio, A. M., Karam, E. G., Shahly, V., Stein, D., Hill, E., Petukhova, M., Alonso, J., Andrade, L., Angermeyer, M., Borges, G., de Girolamo, G., de Graaf, R, Demyttenaere, K., Florescu, S., Mladenova, M., Posada-Villa, J., Scott, K., Takeshima, T. & Kessler, R. C. (2015). Subthreshold Posttraumatic Stress Disorder in the World Health Organization World Mental Health Surveys. *Biological Psychiatry*, *77*(4), 375-384. http://dx.doi.org/10.1016/j.biopsych.2014.03.028

McLaughlin, K., Fairbank, J., Gruber, M., Jones, R., Lakoma, M., Pfefferbaum, B., Sampson, N. & Kessler, R. (2009). Serious emotional disturbance among youths exposed to Hurricane Katrina 2 years postdisaster. *J. Am Acad Child Adol Psychiatry, 48*, 1069-1078.

McNamara, R., Jandacek, R., Rider, T., Tso,P., Chu, W-J, Weber, W., Welge, J., Strawn, J., Adler, C. & DelBello, M. (2016). Effects of fish oil supplementation on prefrontal metabolite concentrations in adolescents with major depressive disorder: a preliminary 1H MRS study. *Nutritional Neuroscience*, *19*(4), 145-155.

Mealings, K. T., Buchholz, J. M., Demuth, K., & Dillon, H. (2015). Investigating the acoustics of a sample of open plan and enclosed Kindergarten classrooms in Australia. *Applied Acoustics*, *100*, 95-105.

Meier, C. (2017, 6 March). Christchurch's specialist mental health services 'on a knife edge'. *The Christchurch Press*. http://www.stuff.co.nz/national/health/89624342/christchurchs-specialist-mental-health-services-on-a-knife-edge

Meiser-Stedman R, Smith P, Glucksman E, Yule W, Dalgleish T; (2008). The posttraumatic stress disorder diagnosis in preschool- and elementary school-age children exposed to motor vehicle accidents. *Am J Psychiatry, 165*,1326-1337.

Meyerson, D. A., Grant, K. E., Carter, J. S., & Kilmer, R. P. (2011). Posttraumatic growth among children and adolescents: A systematic review. *Clinical Psychology Review*, *31*(6), 949-964.

Micha, R., Rogers, P. J. & Nelson, M. (2010). The glycaemic potency of breakfast and cognitive function in school children. *European Journal of Clinical Nutrition*, *64*(9), 948-957.

Micha, R., Rogers, P. J., & Nelson, M. (2011). Glycaemic index and glycaemic load of breakfast predict cognitive function and mood in school children: a randomised controlled trial. *British Journal of Nutrition*, *106*(10), 1552-1561.

Michelson, D., Davenport, C., Dretzke, J., Barlow, J., & Day, C. (2013). Do evidence-based interventions work when tested in the "real world?" A systematic review and meta-analysis of parent management training for the treatment of child disruptive behavior. *Clinical Child and Family Psychology Review*, *16*(1), 18-34.

Minde, K., Roy, J., Bezonsky, R., & Hashemi, A. (2010). The effectiveness of CBT in 3-7 year old anxious children: Preliminary data. *Journal of Canadian Academy of Child and Adolescent Psychiatry, 19(*2), 109-115.

Ministry of Education and BRANZ (2007). *Designing Quality Learning Spaces.* (http://www.education.govt.nz/assets/Documents/Primary-Secondary/Property/School-property-design/Flexible-learning-spaces/BranzLightingDesignGuide.pdf)

Ministry of Education (2009). *Positive Behaviour for Learning (PB4L)*. http://pb4l.tki.org.nz/

Ministry of Education (n.d.) Anticipating and responding to child stress Wellington: Ministry of Education. http://pb4l.tki.org.nz/content/download/331/1521/file/Anticipating%20and%20responding%20to%20child%20stress.pdf

Ministry of Education (2010). *The National Standards.* Wellington: Ministry of Education. http://nzcurriculum.tki.org.nz/National-Standards

Ministry of Education (n.d.). Innovative Learning Environments. http://ile.education.govt.nz/

Ministry of Education (2012). *Annual Report 2011*: Responding to the Canterbury Earthquakes. Wellington: Ministry of Education. http://www.minedu.govt.nz/theMinistry/PublicationsAndResources/AnnualReport/AnnualReport11/CanterburyEarthquakesResponse.aspx

Ministry of Education (2013). *Ka Hikitia, Accelerating Success 2013-2017.* Wellington, New Zealand: Ministry of Education. https://education.govt.nz/assets/Documents/Ministry/Strategies-and-policies/Ka-Hikitia/KaHikitiaAcceleratingSuccessEnglish.pdf

Ministry of Education (2015). Positive Behaviour for Learning: 2015 Update. Wellington: Ministry of Education. Greenberg, M. T., & Harris, A. R. (2012). Nurturing mindfulness in children and youth: Current state of research. *Child Development Perspectives*, *6*(2), 161-166.

Ministry of Education (2016). *The National Curriculum*. Wellington: Ministry of Education. http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum#collapsible2

Ministry of Education (n.d.). *Definitions of Student Achievement*. http://assessment.tki.org.nz/Overall-teacher-judgment/Definitions-of-achievement

Ministry of Health (2013). Health of New Zealand Children. Wellington: Ministry of Health http://www.health.govt.nz/publication/health-new-zealand-children-2011-12

Ministry of Health (2014). *New Zealand Maternity Clinical Indicators 2012.* Wellington: Ministry of Health

Ministry of Health (2015). Guidelines for fluid intake. From: *Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 years): A background paper.* 72-84. Wellington: Ministry of Health.

Ministry of Health (2017a). Māori health models – Te Whare Tapa Whā. Wellington: Ministry of Health. http://www.health.govt.nz/our-work/populations/maori-health/maori-health-models/maori-health-models-te-whare-tapa-wha

Ministry of Health (2017b). Fruit in Schools Programme. Ministry of Health. https://www.health.govt.nz/our-work/life-stages/child-health/fruit-schools-programme

Mistry, R. S., Vandewater, E. A., Huston, A. C., & McLoyd, V. C. (2002). Economic well-being and children's social adjustment: The role of family process in an ethnically diverse low-income sample. *Child Development, 73*(3), 935-951.

Minot, C.S. (1907). The problem of age, growth and health II. Popular science monthly, 71. downloaded from https://en.wikisource.org/wiki/Popular_Science_Monthly/Volume_71/August_1907/The_Problem_of_Age,_Growth_and_Death_II. Illustration courtesy of the Creative Commons Attribution-ShareAlike License;

Mongillo, E. A., Briggs-Gowan, M., Ford, J. D., & Carter, A. S. (2009). Impact of traumatic life events in a community sample of toddlers. *Journal of Abnormal Child Psychology*, *37*(4), 455-468.

Moore, K. W., & Varela, R. E. (2010). Correlates of long-term posttraumatic stress symptoms in children following Hurricane Katrina. *Child Psychiatry & Human Development, 41*(2), 239-250.

Moore, R. (2017). *EAT5 Drinks-An investigation into the drink intake of five-year old children living in New Zealand* (Doctoral dissertation, University of Otago).

Morina, N., Koerssen, R., & Pollet, T. V. (2016). Interventions for children and adolescents with posttraumatic stress disorder: a meta-analysis of comparative outcome studies. *Clinical Psychology Review*, *47*, 41-54.

Morris, M. C., & Rao, U. (2013). Psychobiology of PTSD in the acute aftermath of trauma: Integrating research on coping, HPA function and sympathetic nervous system activity. *Asian Journal of Psychiatry*, *6*(1), 3-21.

Mott, M. S., Robinson, D. H., Williams-Black, T. H., & McClelland, S. S. (2014). The supporting effects of high luminous conditions on grade 3 oral reading fluency scores. *SpringerPlus, 3*(1), 53.

Mott, M. S., Robinson, D. H., Walden, A., Burnette, J., & Rutherford, A. S. (2012). Illuminating the effects of dynamic lighting on student learning. *Sage Open*, 2158244012445585.

Munro, A., Kovats, R. S., Rubin, G. J., Waite, T. D., Bone, A., Armstrong, B., ... & Oliver, I. (2017). Effect of evacuation and displacement on the association between flooding and mental health outcomes: a cross-sectional analysis of UK survey data. *The Lancet Planetary Health*, *1*(4), e134-e141.

Murphy, M., & Fonagy, P. (2012). Mental health problems in children and young people. *Annual Report of the Chief Medical Officer: Our children deserve better; prevention pays*. Chapter 10. London: GovUK. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252660/33571_2901304_CMO_Chapter_10.pdf

Naegeli, C., Zeffiro, T., Piccirelli, M., Jaillard, A., Weilenmann, A., Hassanpour, K., ... & Mueller-Pfeiffer, C. (2017). Locus Coeruleus activity mediates hyperresponsiveness in posttraumatic stress disorder. *Biological Psychiatry*. https://doi-org.ezproxy.canterbury.ac.nz/10.1016/j.biopsych.2017.08.021.

Najarian, L. M., Sunday, S., Labruna, V., & Barry, I. (2011). Twenty-year follow-up of adults traumatized during childhood in Armenia. *Journal of Affective Disorders, 135*(1), 51-55.

National Center for Statistics. (2000). *National Health Interview Survey* (Child Core/Family Core) Atlanta, Georgia, USA: Centers for Disease Control

National Child Traumatic Stress Network (2004). CBITS Cognitive Behavioural Interventions for Trauma in Schools (CBITS). Trauma Treatment Fact Sheets v. 1.0; www.NCRSNet.org, http://ssetprogram.org/_static/tsa/uploads/files//cbits_factsheet_nctsn.pdf

National Longitudinal Surveys (n.d.*a*). *National Longiduinal Survey of Youth 1979: Children and Young Adults*. https://www.nlsinfo.org/content/cohorts/nlsy79-children

National Longitudinal Surveys (n.d.*b*). *Behavior Problem Index. Codebook Supplement*. https://www.nlsinfo.org/content/cohorts/nlsy79-children/other-documentation/codebook-supplement/appendix-d-behavior-problems

National Longitudinal Surveys (n.d.*c*). *Behavior Problem Index. Trichotomous Norms*. https://www.nlsinfo.org/content/cohorts/nlsy79-children/other-documentation/codebook-supplement/appendix-d-behavior-probl-10

National Scientific Council on the Developing Child (2005/2014). S*tress disrupts the architecture of the developing brain*. Working Paper 3: Harvard University, The Center on the Developing Child. Updated Edition. http://www.developingchild.harvard.edu

Neuner F, Schauer E, Catani C, Ruf M, Elbert T (2006) Post-tsunami stress: a study of posttraumatic stress disorder in children living in three severely affected regions in Sri Lanka. *J Trauma Stress, 19*, 339–347.

Neria, Y., Nandi, A. & Galea, S. (2008). Post-traumatic stress disorder following disasters: A systematic review. *Psychological Medicine, 38*(4), 467-80.

Newman, E., Pfefferbaum, B., Kirlic, N., Tett, R., Nelson, S. & Liles, B. (2014). Meta-analytic review of psychological interventions for children survivors of natural and man-made disasters. *Current Psychiatry Reports*, *16*(9), 1-10.

Nielsen (2014). Youth wellbeing survey 2014. Wellington: Canterbury Earthquake Recovery Administration (CERA).

Nielsen. (September, 2015). Wellbeing survey. Wellington: Canterbury Earthquake Recovery Administration (CERA).

Nielsen. (September, 2016). Wellbeing survey. Wellington: Canterbury Earthquake Recovery Administration (CERA).

Nikulina, V., Widom, C. S. & Czaja, S. (2011). The role of childhood neglect and childhood poverty in predicting mental health, academic achievement and crime in adulthood. *American Journal of Community Psychology*, *48*(3-4), 309-321.

Norris, F. H. (2006). Disaster research methods: Past progress and future directions. *Journal of Traumatic Stress*, *19*(2), 173-184.

Norris, F. H., Friedman, M. J., & Watson, P. J. (2002). 60,000 disaster victims speak: Part II. Summary and implications of the disaster mental health research. *Psychiatry: Interpersonal and Biological Processes, 65*(3), 240-260.

Norris, F. H., Friedman, M. J., Watson, P. J., Byrne, C. M., Diaz, E., & Kaniasty, K. (2002). 60,000 disaster victims speak: Part I. An empirical review of the empirical literature, 1981–2001. P*sychiatry: Interpersonal and Biological Processes, 65*(3), 207-239.

Norris, F. H., & Kaniasty, K. (1992). Reliability of delayed self□reports in disaster research. *Journal of Traumatic Stress, 5(*4), 575-588.

Norris, F. H. & Kaniasty, K. (1996). Received and perceived social support in times of stress: a test of the social support deterioration deterrence model. *Journal of Personality and Social Psychology, 71*(3), 498-511.

North, C. S., & Pfefferbaum, B. (2013). Mental health response to community disasters: a systematic review. *Journal of the American Medical Association*, *310*(5), 507-518.

O'Donnell, M. H., & Behie, A. M. (2013). Effects of bushfire stress on birth outcomes: A cohort study of the 2009 Victorian Black Saturday bushfires. International *Journal of Disaster Risk Reduction, 5,* 98-106

O'Donnell, K., O'Connor, T. G., & Glover, V. (2009). Prenatal stress and neurodevelopment of the child: focus on the HPA axis and role of the placenta. *Developmental Neuroscience, 31*(4), 285-292.

Office for Standards in Education, Children's Services and Skills [Ofsted](2014) *Below the radar: Low level disruption in the coutry's classrooms. No. 140.* www.ofsted.gov.uk/resources/140157

Olff, M. (2017). Sex and gender differences in post-traumatic stress disorder: an update. *European Journal of Psychotraumatology*, *8*(sup4), 1351204.

Okuyama, J., Funakoshi, S., Tomita, H., Yamaguchi, T., & Matsuoka, H. (2017). Mental health and school-based intervention among adolescent exposed to the 2011 Great East Japan Earthquake and tsunami. *International Journal of Disaster Risk Reduction*, *24*, 183-188.

Oncu, E. & Wise, A. (2010). The effects of the 1999 Turkish earthquake on young children: analyzing traumatized children's completion of short stories. *Child Development, 81*(4), 1161-1175.

O'Neill, L., George, S. & Wagg, J. (n.d.) *Trauma-Informed Classroom Strategies*. Vancouver, B.C., Canada: University of British Columbia.

O'Neill, L., Fraser, T., Kitchenham, A., & McDonald, V. (2016). Hidden Burdens: a Review of Intergenerational, Historical and Complex Trauma, Implications for Indigenous Families. *Journal of Child & Adolescent Trauma*, 1-14.

Ortega, R. M., Rodríguez-Rodríguez, E., & López-Sobaler, A. M. (2012). Effects of omega 3 fatty acids supplementation in behavior and non-neurodegenerative neuropsychiatric disorders. *British Journal of Nutrition*, *107*(S2), S261-S270.

Osborne, M. (2016). *Innovative Learning Environments*. CORE Education: http://blog.core-ed.org/files/2017/01/Innovative-Learning-Environments-FINAL-web.pdf.

Osman, H., & Sullivan, J. R. (2014). Children's auditory working memory performance in degraded listening conditions. *Journal of Speech, Language, and Hearing Research, 57*(4), 1503-1511.

Osofsky, J. D., Osofsky, H. J., Weems, C. F., King, L. S. & Hansel, T. C. (2015). Trajectories of post□traumatic stress disorder symptoms among youth exposed to both natural and technological disasters. *Journal of Child Psychology and Psychiatry, 56*(12), 1347-1355.

Overstreet, S. & Chafouleas, S. (2016). Trauma-informed schools: Introduction to the Special Issue. *School Mental Health, 8*(1), 1-6.

Overstreet, S., Salloum, A., Burch, B. & West, J. (2011). Challenges associated with childhood exposure to severe natural disasters: Research review and clinical implications. *J. Child and Adolescent Trauma, 4*, 52-68.

Oyarzo, C., Bertoglia, P., Avendaño, R., Bacigalupo, F., Escudero, A., Acurio, J. & Escudero, C. (2012). Adverse perinatal outcomes after the Feb 27th 2010 Chilean earthquake. *Journal of Maternal-Fetal and Neonatal Medicine, 25*(10), 1868-1873.

Palgi, Y., Gelkopf, M., & Berger, R. (2015). The inoculating role of previous exposure to potentially traumatic life events on coping with prolonged exposure to rocket attacks: A lifespan perspective. *Psychiatry Research*, *227*(2), 296-301.

Panagioti, M., Gooding, P. A., Triantafyllou, K., & Tarrier, N. (2015). Suicidality and posttraumatic stress disorder (PTSD) in adolescents: a systematic review and meta-analysis. *Social Psychiatry and Psychiatric Epidemiology*, *50*(4), 525-537.

Pang, K. C. & Beauchaine, T. P. (2013), Longitudinal patterns of autonomic nervous system responding to emotion evocation among children with conduct problems and/or depression. *Dev. Psychobiol., 55*, 698–706. doi: 10.1002/dev.21065

Panel Study on Income Dynamics (PSID) (2017). Child Development Supplement. Behavior Problem Index. https://psidonline.isr.umich.edu/Guide/FAQ.aspx?Type=2

Panel Study of Income Dynamics (PSID). (2010). *Child Development Supplement User Guide for CDS-II , Positive Behaviors Scale*. The Institute for Social Research. Ann Arbor, MI. https://psidonline.isr.umich.edu/CDS/cdsii_userGd.pdf

Paxson, C., Fussell, E., Rhodes, J., & Waters, M. (2012). Five years later: Recovery from posttraumatic stress and psychological distress among low-income mothers affected by Hurricane Katrina. *Social Science & Medicine*, *74*(2), 150-157.

Pattemore, P. K., Ellison□Loschmann, L., Asher, M. I., Barry, D. M., Clayton, T. O., Crane, J., D'Souza, J., Ellwood, P., Ford, R., Mackay, R., Mitchell, E., Moyes, C., Pearce, N. & Stewart, A. W. (2004). Asthma prevalence in European, Maori, and Pacific children in New Zealand: ISAAC study. *Pediatric Pulmonology, 37*(5), 433-442.

Paull, S. (2015, May 18). Landmark lawsuit filed in California to make trauma-informed practices mandatory for all public schools. *ACES Too High News*. https://acestoohigh.com/2015/05/18/landmark-lawsuit-filed-to-make-trauma-informed-practices-mandatory-for-all-public-schools/

Paxson, C., Fussell, E., Rhodes, J., & Waters, M. (2012). Five years later: Recovery from posttraumatic stress and psychological distress among low-income mothers affected by Hurricane Katrina. *Social Science & Medicine, 74*(2), 150-157.

Pearson, J. & Hall, D. (2006, 2017). *Reaching In ... Reaching Out Resiliency Guidebook.* Toronto, CA: Child and Family Partnership.www.reachinginreachingout.com/resouces-guidebook.htm.

Pechtel, P., & Pizzagalli, D. A. (2011). Effects of early life stress on cognitive and affective function: an integrated review of human literature. *Psychopharmacology*, *214*(1), 55-70.

Peek, L. (2008). Children and disasters: understanding vulnerability, developing capacities, and promoting resilience—an introduction. *Children Youth and Environments*, *18*(1), 1-29.

Pereira, E. R. B. N., Tavares, E. L. M., & Martins, R. H. G. (2015). Voice disorders in teachers: clinical, videolaryngoscopical, and vocal aspects. *Journal of Voice, 29*(5), 564-571.

Perfect, M. M., Turley, M. R., Carlson, J. S., Yohanna, J., & Saint Gilles, M. P. (2016). School-related outcomes of Traumatic event exposure and traumatic stress symptoms in students: A systematic review of research from 1990 to 2015. *School Mental Health*, *8*(1), 7-43.

Peterson J. L, & Zill N. (1986). Marital disruption, parent-child relationships, and behavior problems in children. *J Marriage Fam., 48*, 295–307.

Pfefferbaum, B. (1997). Posttraumatic stress disorder in children: A review of the past 10 years. *Journal of the American Academy of Child & Adolescent Psychiatry*, *36*(11), 1503-1511.

Pfefferbaum, B., Nitiéma, P., Tucker, P. & Neuman, E. (2017). Early child disaster mental health interventions: A review of the empirical evidence. *Child & Youth Care Forum,* 1-22. doi:10.1007/s10566-017-9397-y

Pfefferbaum, B., Varma, V., Nitiéma, P., & Newman, E. (2014). Universal preventive interventions for children in the context of disasters and terrorism. *Child and Adolescent Psychiatric Clinics of North America*, *23*(2), 363.

Pfefferbaum, B., Weems, C. F., Scott, B. G., Nitiéma, P., Noffsinger, M. A., Pfefferbaum, R. L, Varma, V. & Chakraburtty, A. (2013), Research methods in child disaster studies: A review of studies generated by the September 11, 2001, Terrorist Attacks; the 2004 Indian Ocean Tsunami; and Hurricane Katrina. *Child & Youth Care Forum, 42*(4), 285-337. NIH Public Access.

Piaget, J. (1951). *The child's conception of the world* (No. 213). Rowman & Littlefield.

Piaget, J., & Inhelder, B. (2014). *The origin of the idea of chance in children.* Psychology Press: Psychology Revivals.

Piccardi, L., Palmiero, M., Nori, R., Baralla, F., Cordellieri, P., D'Amico, S., & Giannini, A. M. (2017). Persistence of traumatic symptoms after 7 Years: Evidence from young individuals exposed to the L'aquila Earthquake. *Journal of Loss and Trauma*, *22*(6), 487-500.

Pinto-Gouveia, J., & Matos, M. (2011). Can shame memories become a key to identity? The centrality of shame memories predicts psychopathology. *Applied Cognitive Psychology, 25*(2), 281-290.

Polit, D. (1998). *The Positive Behavior Scale*. Saratoga Springs, NY: Humanalysis.

Pollio, D. E., McClendon, J. B., North, C. S., Reid, D., & Jonson-Reid, M. (2005). The promise of school-based psychoeducation for parents of children with emotional disorders. *Children & Schools*, *27*(2), 111.

Portilla, X. A., Ballard, P. J., Adler, N. E., Boyce, W. T., & Obradović, J. (2014). An integrative view of school functioning: Transactions between self□regulation, school engagement, and teacher–child relationship quality. *Child Development, 85*(5), 1915-1931.

Porto, P. R., Oliveira, L., Mari, J., Volchan, E., Figueira, I., & Ventura, P. (2009). Does cognitive behavioral therapy change the brain? A systematic review of neuroimaging in anxiety disorders. *The Journal of neuropsychiatry and clinical neurosciences*, *21*(2), 114-125.

Powell, T., & Thompson, S. J. (2016). Enhancing coping and supporting protective factors after a disaster: Findings from a quasi-experimental study. *Research on Social Work Practice*, *26*(5), 539-549.

Price, J., & Just, D. R. (2015). Lunch, recess and nutrition: Responding to time incentives in the cafeteria. *Preventive Medicine, 71,* 27-30.

Primack, B. A. (2003). The WHO-5 Well-being Index performed the best in screening for depression in primary care. *Evidence Based Medicine, 8*(5), 155-159.

Prinstein, M., LaGreca, A., Vernberg, E., & Silverman, W. (1996). Children's coping assistance: How parents, teachers and friends help children cope after a natural disaster. *Journal of Clinical Child Psychology, 25*(4), 463-475.

Proctor, L. J., Fauchier, A., Oliver, P. H., Ramos, M. C., Rios, M. A. & Margolin, G. (2007). Family context and young children's responses to earthquakes. *Journal of Child Psychology and Psychiatry, 48*(9), 941-949.

Provençal, N., & Binder, E. B. (2015). The effects of early life stress on the epigenome: from the womb to adulthood and even before. *Experimental Neurology*, *268*, 10-20.

Pynoos, R. S., Goenjian, A., Tashjian, M., Karakashian, M., Manjikian, R., Manoukian, G., ... & Fairbanks, L. A. (1993). Post-traumatic stress reactions in children after the 1988 Armenian earthquake. *The British Journal of Psychiatry*, *163*(2), 239-247.

Quakebot (2017, 20 Sept). Earthqake: 3.2 earthquake strikes near San Jan Bautista, Calif. http://www.latimes.com/local/lanow/la-me-earthquakesa-earthquake-32-quake-strikes-near-san-juan-bautista-calif-zldl-story.html

Raanaas, R. K., Evensen, K. H., Rich, D., Sjøstrøm, G., & Patil, G. (2011). Benefits of indoor plants on attention capacity in an office setting. *Journal of Environmental Psychology*, *31*(1), 99-105.

Rabinak, C. A., Mori, S., Lyons, M., Milad, M. R. & Phan, K. L. (2017). Acquisition of CS-US contingencies during Pavlovian fear conditioning and extinction in social anxiety disorder and posttraumatic stress disorder. *Journal of Affective Disorders*, *207*, 76-85.

Raine, A. (1996). Autonomic nervous system factors underlying disinhibited, antisocial, and violent behavior: Biosocial perspectives and treatment implications. *Annals of the New York Academy of Sciences*, *794*(1), 46-59.

Raine, A., Portnoy, J., Liu, J., Mahoomed, T., & Hibbeln, J. R. (2015). Reduction in behavior problems with omega□3 supplementation in children aged 8–16 years: a randomized, double□blind, placebo□controlled, stratified, parallel□group trial. *Journal of Child Psychology and Psychiatry*, *56*(5), 509-520.Pale blue light: http://www.makegreatlight.com/blog/can-classroom-lighting-help-keep-students-alert

Rainville, A. J., Wolf, K. N., & Carr, D. H. (2006). Recess placement prior to lunch in elementary schools: what are the barriers. *Journal of Child Nutrition & Management, 30,* (2), n.p.

Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J. & Metzl, J. D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *Journal of the American Dietetic Association*, *105*(5), 743-760.

Ramstetter, C. L., Murray, R., & Garner, A. S. (2010). The crucial role of recess in sc*hools. Journal of School Health*, *80*(11), 517-526.

Rapp C. A., Etzel-Wise D., Marty D., Coffman M., Carlson L., Asher D., . . . Holter M. (2010). Barriers to evidence-based practice implementation: Results of a qualitative study. *Community Mental Health Journal, 46*, 112–118.

Rath, B., Young, E. A., Harris, A., Perrin, K., Bronfin, D. R., Ratard, R., VanDyke, R., Goldshore, M. & Magnus, M. (2011). Adverse respiratory symptoms and environmental exposures among children and adolescents following Hurricane Katrina. *Public Health Reports*, 853-860.

Rees, C. (2014). Lost among the trees? The autonomic nervous system and paediatrics. *Archives of Disease in Childhood, 99*, 552-562.

Reid, J., Taylor-Moore, K., & Varona, G. (2014). Towards a social-structural model for understanding current disparities in Maori health and well-being. *Journal of Loss and Trauma*, *19*(6), 514-536.

Reis, C. & Hibbeln, J.R. (2006). Cultural symbolism of fish and the psychotropic properties of omega-3 fatty acids. *Prostaglandins, Leukotrienes and Essential Fatty Acids, 75* (4/5), 227-236

Ren, J. H., Chiang, C. L. V., Jiang, X. L., Luo, B. R., Liu, X. H., & Pang, M. C. (2014). Mental disorders of pregnant and postpartum women after earthquakes: a systematic review. *Disaster Medicine and Public Health Preparedness, 8(*04), 315-325.

Reyners, M., Eberhart-Phillips, D. & Martin, S. (2014). Prolonged Canterbury earthquake sequence linked to widespread weakening of strong crust. *Nature Geoscience, 7*(1), 34-37.

Reynolds, M., & Brewin, C. R. (1998). Intrusive cognitions, coping strategies and emotional responses in depression, post-traumatic stress disorder and a non-clinical population. *Behaviour Research and Therapy*, *36*(2), 135-147.

Reynolds, C. R. & Richmond, B.O. (1997). What I think and feel: A revised measure of Children's Manifest Anxiety. *Journal of Abnormal Child Psychology, 25*(1), 15-20.

Rhodes, J., Chan, C., Paxson, C., Rouse, C. E., Waters, M., & Fussell, E. (2010). The impact of hurricane Katrina on the mental and physical health of low□income parents in New Orleans. *American Journal of Orthopsychiatry, 80*(2), 237-247.

Richardson, A. (2015). Omega□3 and sleep: New insights from the DHA Oxford Learning and Behaviour (DOLAB) study. *Lipid Technology*, *27*(5), 103-106.

Ring, B. M., Sigurdsson, S. O., Eubanks, S. L., & Silverman, K. (2014). Reduction of classroom noise levels using group contingencies. *Journal of Applied Behavior Analysis*, *47*(4), 840-844.

Robson, D. (2017,)c 12). A new way to look at emotions – and how to master yours. BBC.Com Future, Psychology. http://www.bbc.com/future/story/20171012-how-emotions-can-trick-your-mind-and-body

Rodgers, J. L., Van Hulle, C., D'Onofrio, B., Rathouz, P., Beasley, W., Johnson, A., ... & Lahey, B. B. (2015). Behavior problems and timing of menarche: a developmental longitudinal biometrical analysis using the NLSY-Children data. *Behavior genetics*, *45*(1), 51-70.

Roeser, R. W., Schonert-Reichl, K. A., Jha, A., Cullen, M., Wallace, L., Wilensky, R., ... & Harrison, J. (2013). Mindfulness training and reductions in teacher stress and burnout: Results from two randomized, waitlist-control field trials. *Journal of Educational Psychology*, *105*(3), 787.

Rolfsnes, E. & Idsoe, T. (2011). School-based intervention programs for PTSD symptoms: A review and meta-analysis. *Journal of Traumatic Stress, 24*(2), 155-165.

Ronald, A., Pennell, C. E. & Whitehouse, A. J. (2011). Prenatal maternal stress associated with ADHD and autistic traits in early childhood. *Frontiers in Psychology, 1(*223) 1-8.

Rosenman, M., Sturm, A., McCracken,J. et al. (2017) Autonomic arousal in anxious and typically developing youth during a stressor involving error feedback. *European Child and Adolescent Psychiatry*, 1-10 doi:10.1007/s00787-017-1001-3
Roeser, R. W., Schonert-Reichl, K. A., Jha, A., Cullen, M., Wallace, L., Wilensky, R., ... & Harrison, J. (2013). Mindfulness training and reductions in teacher stress and burnout: Results from two randomized, waitlist-control field trials. *Journal of Educational Psychology*, *105*(3), 787.
Rosner, R., Arnold, J., Groh, E. M., & Hagl, M. (2012). Predicting PTSD from the Child Behavior Checklist: Data from a field study with children and adolescents in foster care. *Children and Youth Services Review, 34*(9), 1689-1694.

Ross, K. & Shuell, T. (1993). Children's beliefs about earthquakes. *Science Education, 77* (2), 191-205.

Roth, T. L., Lubin, F. D., Sodhi, M., & Kleinman, J. E. (2009). Epigenetic mechanisms in schizophrenia. *Biochimica et Biophysica Acta (BBA)-General Subjects, 1790*(9), 869-877.

Roussos, A., Goenjian, A. K., Steinberg, A. M., Sotiropoulou, C., Kakaki, M., Kabakos, C., ... & Manouras, V. (2005). Posttraumatic stress and depressive reactions among children and adolescents after the 1999 earthquake in Ano Liosia, Greece. *American Journal of Psychiatry*, *162*(3), 530-537.

Ruigrok, A. N., Salimi-Khorshidi, G., Lai, M. C., Baron-Cohen, S., Lombardo, M. V., Tait, R. J., & Suckling, J. (2014). A meta-analysis of sex differences in human brain structure. *Neuroscience & Biobehavioral Reviews*, *39*, 34-50.

Rutter, H., Savona, N., Glonti, K., Bibby, J., Cummins, S., Finegood, D. T., ... & Petticrew, M. (2017). The need for a complex systems model of evidence for public health. *Lancet*. Available from: http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)31267-9/fulltext

Sachdev, P. S. (1990). Behavioural factors affecting physical health of the New Zealand Maori. *Social Science & Medicine*, *30*(4), 431-440.

Sadeh, A., Gruber, R., & Raviv, A. (2002). Sleep, neurobehavioral functioning, and behavior problems in school□age children. *Child development*, *73*(2), 405-417.

Sailer, U., Robinson, S., Fischmeister, F. P. S., König, D., Oppenauer, C., Lueger-Schuster, B., ... & Bauer, H. (2008). Altered reward processing in the nucleus accumbens and mesial prefrontal cortex of patients with posttraumatic stress disorder. *Neuropsychologia*, *46*(11), 2836-2844.

Şalcıoğlu, E. & Başoğlu, M. (2008). Psychological effects of earthquakes in children: Prospects for brief behavioral treatment. *World Journal of Pediatrics, 4*(3), 165-172.

Salmon, K., & Bryant, R. A. (2002). Posttraumatic stress disorder in children: The influence of developmental factors. *Clinical Psychology Review*, *22*(2), 163-188.

Salmon, K., Sinclair, E., & Bryant, R. A. (2007). The role of maladaptive appraisals in child acute stress reactions. *British Journal of Clinical Psychology*, *46*(2), 203-210.

Salmond, C., & Crampton, P. (2012). Measuring socioeconomic position in New Zealand. *J Prim Health Care, 4(*4), 271-280.

Salmond, C., Crampton, P., King, P., & Waldegrave, C. (2006). NZiDep: a New Zealand index of socioeconomic deprivation for individuals. *Social science & medicine*, *62*(6), 1474-1485.

Sameroff, A. & Haith, M. (1996). *The five to seven year shift: The age of reason and responsibility*. Chicago: University of Chicago Press.

Santiago, P. N., Ursano, R. J., Gray, C. L., Pynoos, R. S., Spiegel, D., Lewis-Fernandez, R., Friedman, M., & Fullerton, C. S. (2013). A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: intentional and non-intentional traumatic events. *PloS One, 8*(4), e59236

Saunders, B. & Adams, Z. (2014) Epidemiology of traumatic experiences in childhood. *Child and Adolescence Psychiatric Clinics of North America, 23*(2), 167-184.

Saylor C.F. (2002). *The Pediatric Emotional Distress Scale (PEDS)*. Available from Conway Saylor, PhD, Department of Psychology, The Citadel, 171 Moultrie Avenue, Charleston, SC 29409 (conway.saylor@citadel.edu).

Saylor, C.F, Swenson, C. C., Reynolds, S.S., & Taylor, M. (1999). The Pediatric Emotional Distress Scale: A brief screening measure for young children exposed to traumatic events. *Journal of Clinical Child Psychology, 28(*1), 70-81.

Scharf, R. J., Demmer, R. T., & DeBoer, M. D. (2013). Longitudinal evaluation of milk type consumed and weight status in preschoolers. *Archives of Disease in Childhood, 98*(5), 335-340.

Scheeringa, M. (2008). Developmental considerations for diagnosing PTSD and acute stress disorder in preschool and school-age children. *American Journal of Psychiatry*, *165*(10), 1237-1239.

Scheeringa, M. (2012). Child PTSD Checklist-Child Version (CPC). http://www.midss.org/sites/default/files/ycpc.pdf

Scheeringa, M. (3 January 2014). *PTSD for children 6 years and younger*. National Center for PTSD: US Department of Veteran Affairs. Downloaded from: http://www.ptsd.va.gov/professional/PTSD-overview/ptsd_children_6_and_younger.asp

Scheeringa, M. S., Peebles, C. D., Cook, C. A., & Zeanah, C. H. (2001). Toward establishing procedural, criterion, and discriminant validity for PTSD in early childhood. *Journal of the American Academy of Child & Adolescent Psychiatry*, *40*(1), 52-60.

Scheeringa, M. S., & Zeanah, C. H. (2001). A relational perspective on PTSD in early childhood. *Journal of Traumatic Stress*, *14*(4), 799-815.

Scheeringa, M. S., & Zeanah, C. H. (2008). Reconsideration of harm's way: Onsets and comorbidity patterns of disorders in preschool children and their caregivers following Hurricane Katrina. *Journal of Clinical Child & Adolescent Psychology, 37*(3), 508-518.

Scheeringa, M. S., Zeanah, C. H., & Cohen, J. A. (2011). PTSD in children and adolescents: toward an empirically based algorithm. *Depression and anxiety*, *28*(9), 770-782.

Scheeringa, M. S., Zeanah, C. H., Myers, L., & Putnam, F. W. (2003). New findings on alternative criteria for PTSD in preschool children. *Journal of the American Academy of Child & Adolescent Psychiatry*, *42*(5), 561-570.

Scheeringa, M. S., Zeanah, C. H., Myers, L., & Putnam, F. W. (2005). Predictive Validity in a prospective follow-up of PTSD in preschool children. *Journal of the American Academy of Child & Adolescent Psychiatry, 44*(9), 899-906.

Scheeringa, M., Zeanah, C. & Cohen, J. (2011). PTSD in children and adolescents: Toward an empirically based algorithm. *Depression and Anxiety, 28*, 770-778.

Scheeringa, M., Zeanah, C. & Myers, L. (2005). Predictive validity in a prospective follow-up of PTSD in preschool children. *J Amer Acad Child Adol Psychiatry, 44*(9), 899-906.

Schiavone, S., Colaianna, M., & Curtis, L. (2015). Impact of early life stress on the pathogenesis of mental disorders: relation to brain oxidative stress. *Current Pharmaceutical Design*, *21*(11), 1404-1412.

Schiff, A.J. (Ed.). (1999). *Guide to improved earthquake performance of power systems* (No.96). ASCE Manuals and Reports on Engineering Practice.

Schonert-Reichl, K. A. & Lawlor, M. S. (2010). The effects of a mindfulness-based education program on pre- and early adolescents' well-being and social and emotional competence. *Mindfulness*, *1*(3), 137-151.

Schnurr, P. P., Lunney, C. A., & Sengupta, A. (2004). Risk factors for the development versus maintenance of posttraumatic stress disorder. *Journal of Traumatic Stress, 17*(2), 85-95.

Schnyder, U., Ehlers, A., Elbert, T., Foa, E. B., Gersons, B. P., Resick, P. A., ... & Cloitre, M. (2015). Psychotherapies for PTSD: what do they have in common? *European Journal of Psychotraumatology, 6*(1), 281-86.

Schuchardt, J. P., Huss, M., Stauss-Grabo, M., & Hahn, A. (2010). Significance of long-chain polyunsaturated fatty acids (PUFAs) for the development and behaviour of children. *European Journal of Pediatrics*, *169*(2), 149-164.

Schultz, J-H., Langeballe, A. & Raundalen, M. (2014). Explaining the unexplainable: designing a national strategy on classroom communication concerning the 22 July terror attack in Norway. *European Journal of Psychotraumatology, 5* (1), 22758.

Schumm, P. (2004). *Sample Size Calculations for Longitudinal Studies*. University of Chicago: Chicago IL. http://repec.org/nasug2004/nasug2004_longpower.pdf. Accessed: 6 September 2007.

Shaw, J. A., Applegate, B., Tanner, S., Perez, D., Rothe, E., Campo-Bowen, A. E., & Lahey, B. L. (1995). Psychological effects of Hurricane Andrew on an elementary school population. *Journal of the American Academy of Child & Adolescent Psychiatry*, *34*(9), 1185-1192.

Shaw, J. A., Espinel, Z., & Shultz, J. M. (2012). *Care of children exposed to the traumatic effects of disaster.* American Psychiatric Pub.

Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of classroom ventilation rate and temperature on students' test scores. *PloS one*, *10*(8), e0136165.

Seery, M. D., Holman, E. A., & Silver, R. C. (2010). Whatever does not kill us: cumulative lifetime adversity, vulnerability, and resilience. *Journal of personality and social psychology*, *99*(6), 1025.

Shield, B. M. & Dockrell, J. E. (2003). The effects of noise on children at school: a review. *Building Acoustics*, *10*(2), 97-116.

Shield, B., Greenland, E. & Dockrell, J. (2010). Noise in open plan classrooms in primary schools: A review. *Noise and Health, 12*(49), 225. http://www.noiseandhealth.org/article.asp?issn=1463-1741;year=2010;volume=12;issue=49;spage=225;epage=234;aulast=Shield

Shirlaw, N. (2014). *Children and the Canterbury Quakes.* Auckland: Child Poverty Action Group. http://www.cpag.org.nz/assets/Backgrounders/140227%20CPAG%20Children%20and%20the%20Canterbury%20Feb2014.pdf

Shonkoff, J. P., Boyce, W. T., & McEwen, B. S. (2009). Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention. *Journal of the American Medical Association, 301*(21), 2252-2259.

Shonkoff, J. P., Garner, A. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., McGuinn, L., Pascoe, J. & Wood, D. L. (2012). The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*, *129*(1), e232-e246.

Sinclair, V. G., Wallston, K. A., & Strachan, E. (2016). Resilient coping moderates the effect of trauma exposure on depression. *Research in Nursing & Health*, *39*(4), 244-252.

Sinha, R., & Jastreboff, A. M. (2013). Stress as a common risk factor for obesity and addiction. *Biological Psychiatry, 73*(9), 827-835.

Skaalvik, E. M., & Skaalvik, S. (2007). Dimensions of teacher self-efficacy and relations with strain factors, perceived collective teacher efficacy, and teacher burnout. *Journal of Educational Psychology*, *99*(3), 611.

Sleegers, P. J. C., Moolenaar, N. M., Galetzka, M., Pruyn, A., Sarroukh, B. E. & van der Zande, B. (2012). Lighting affects students' concentration positively: Findings from three Dutch studies. *Lighting Research and Technology*, 1477153512446099.

Sleegers, P. J. C., Moolenaar, N. M., Galetzka, M., Pruyn, A., Sarroukh, B. E. & van der Zande, B. (2012). Lighting affects students' concentration positively: Findings from three Dutch studies. *Lighting Research and Technology*, 1477153512446099.

Slee, P. T. (1993). Children, stressful life events and school adjustment: An Australian study. *Educational Psychology*, *13*(1), 3-10. Parent Life Events Survey available: http://www.caper.com.au/pages/adultsurv.htm

Smith, K. (2013). *Environmental Hazards: Assessing Risk and Reducing Disaster.* 6th Edition. London: Routledge.

Smith, A. P., & Wilds, A. (2009). Effects of cereal bars for breakfast and mid-morning snacks on mood and memory. *International Journal of Food Sciences and Nutrition*, *60*(sup4), 63-69.

Smith, P., Perrin, S., Dalgleish, T., Meiser-Stedman, R., Clark, D. M., & Yule, W. (2013). Treatment of posttraumatic stress disorder in children and adolescents. *Current Opinion in Psychiatry*, *26*(1), 66-72.

Social Policy Research and Evaluation Unit (2017). *Journeys of resilience: From adverse childhoods to achieving in adulthood*. Wellington: http://www.superu.govt.nz/sites/default/files/Journeys-of-resilience_0.pdf

Spell, A. W., Kelley, M. L., Wang, J., Self-Brown, S., Davidson, K. L., Pellegrin, A., ... & Baumeister, A. (2008). The Moderating Effects of Maternal Psychopathology on Children's Adjustment Post–Hurricane Katrina. *Journal of Clinical Child & Adolescent Psychology, 37*(3), 553-563.

Spittlehouse, J. K., Joyce, P. R., Vierck, E., Schluter, P. J., & Pearson, J. F. (2014). Ongoing adverse mental health impact of the earthquake sequence in Christchurch, New Zealand. *Australian & New Zealand Journal of Psychiatry*, *48*(8), 756-763.

Spitzer, J., Schrager, S. M., Imagawa, K. K., & Vanderbilt, D. L. (2017). Clinician disparities in anxiety and trauma screening among children with ADHD: A pilot study. *Children's Health Care*, *46*(4), 344-355.

Sprung, M. (2008). Unwanted intrusive thoughts and cognitive functioning in kindergarten and young elementary school-age children following Hurricane Katrina. *Journal of Clinical Child and Adolescent Psychology, 37*(3), 575-587.

Sprung, M., & Harris, P. L. (2010). Intrusive thoughts and young children's knowledge about thinking following a natural disaster. *Journal of Child Psychology and Psychiatry, 51*(10), 1115-1124.

Spruyt, K., Molfese, D. L., & Gozal, D. (2011). Sleep duration, sleep regularity, body weight and metabolic homeostasis in school-aged children. *Pediatrics, 127*(2), e345-e352.

Stallard, P., Salter, E., & Velleman, R. (2004). Posttraumatic stress disorder following road traffic accidents. *European Child & Adolescent Psychiatry, 13*(3), 172-178.

Statistics New Zealand (2013). 2013 Census QuickStats about Greater Christchurch. downloaded 14 January 2015 from: http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-greater-chch/age-sex.aspx

Statistics New Zealand (2014). *New Zealand 2013 Disability Survey*. Wellington: Statistics New Zealand.

Statistics New Zealand (2015). *New Zealand 2013 Census.* Wellington: Statistics New Zealand. *http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-greater-chch/population-change.aspx; http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-greater-chch/cultural-diversity.aspx;*

Statistics New Zealand (2016). Families and whānau status report. Wellington: New Zealand government. http://www.superu.govt.nz/publication/families_whanau_report_2016

Stavrou, S., Nicolaides, N. C., Critselis, E., Darviri, C., Charmandari, E., & Chrousos, G. P. (2017). Pediatric Stress: From Neuroendocrinology to Contemporary Disorders. *European journal of clinical investigation*,*47*(3), 262-269.

Steinberg, A. M., Brymer, M. J., Steinberg, J. R., & Pfefferbaum, B. (2006). Conducting research on children and adolescents after disaster. In F. Norris, S., Galea, M. Friedman & P. Watson, (Eds). *Methods for Disaster Mental Health Research*, 243-253. The Guiliford Press.

Stepleman, L., & Wright, D. & A. Bottonari, K. (2009). Socioeconomic status: Risks and resilience. In S. Loue & M. Saiatovic, (Eds). *Determinants of Minority Mental Health and Wellness,* 1-30. Cleveland, OH: Case Western Reserve University. 10.1007/978-0-387-75659-2_13.

Stevens, L. J., Zentall, S. S., Abate, M. L., Kuczek, T., & Burges, J. R. (1996). Omega-3 fatty acids in boys with behavior, learning, and health problems. *Physiology & Behavior*, *59*(4), 915-920.

Stevens, J. S. (2012, 28 February). Spokane, WA, students' trauma prompts search for solutions. *ACES Too High News*. https://acestoohigh.com/2012/02/28/spokane-wa-students-child-trauma-prompts-search-for-prevention/

Stoddard, F. J. (2014). Outcomes of traumatic exposure. *Child and Adolescent Psychiatric Clinics of North America*, *23*(2), 243-256.

Strand, V., Sarmiento, T., & Pasquale, L. (2005). Assessment and screening tools for trauma in children and adolescents: A review. *Trauma, Violence & Abuse, 6,* 55- 78. DOI: 10.1177/1524838004272559

Sun, G., Shook, T. & Kay, G. (1996). Inappropriate use of bivariable analysis to screen risk factors for use in multivariable analysis. *J Clin Epidemiol., 49(*8):907-16.

Sun, X. Y., Fan, H. M., Bai, B., Song, H. T., Tao, F. Y., Song, Z. X., ... & Zhang, L. Y. (2014). Psychosomatic conditions of the children and adolescents exposed to 5.12 Wenchuan earthquake. *International Journal of Behavioral Medicine*, *21*(4), 730-735.

Social Policy Research and Evaluation Unit (SUPERU) (2014). *Services and Support for Families and Whanau in Christchurch*. Wellington: Families Commission. ISBN 978-0-478-44051-5 (Online).

Stoddard, F. (2014). Outcomes of Trauma. *Child and Adolescent Psychiatric Clinics of North America, 23* (2), 243-256.

Swenson, C. C., Saylor, C. F., Powell, M. P., Stokes, S. J., Foster, K. Y. & Belter, R. W. (1996). Impact of a natural disaster on preschool children: adjustment 14 months after a hurricane. *The American Journal of Orthopsychiatry, 66*(1), 122-130.

Thabet, A. A., & Vostanis, P. (2000). Post traumatic stress disorder reactions in children of war: a longitudinal study. *Child Abuse & Neglect*, *24*(2), 291-298.

Takada, S. (2013). Post-traumatic stress disorders and mental health care (lessons learned from the Hanshin-Awaji Earthquake, Kobe, 1995). *Brain and Development, 35*, 214-219

Tanaka, C., Richards, K. L., Takeuchi, L. S., Otani, M., & Maddock, J. (2005). Modifying the recess before lunch program: a pilot study in Kaneohe elementary schoo*l. California Journal of Health Promotion, 3*(4), 1-7

Tan, C.E., Li, H. J., Zhang, X. G., Zhang, H., Han, P. Y., An, Q. & Wang, M.Q. (2009). The impact of the Wenchuan earthquake on birth outcomes. *PloS One, 4*(12): e:8200.

Taylor, C., Harrison, J., Haimovitz, K., Oberle, E., Thomson, K., Schonert-Reichl, K., & Roeser, R. W. (2016). Examining ways that a mindfulness-based intervention reduces stress in public school teachers: A mixed-methods study. *Mindfulness*, *7*(1), 115-129.

Te Pou o te Whakaaro Nui (2017). *Supporting organisations to develop their workforce- Hikitia! Hāpainga!* https://www.tepou.co.nz/resources/trauma-informed-care-workshop-resources/226

Thabet, A. M., Tawahina, A. A., El Sarraj, E., Henely, D., Pelleick, H., & Vostanis, P. (2013). Comorbidity of post traumatic stress disorder, attention deficit with hyperactivity, conduct, and oppositional defiant disorder in Palestinian children affected by war on Gaza. *Health*, *5*(06), 994.

Thakur, A., Creedon, J., & Zeanah, C. H. (2015). Trauma-and stressor-related disorders among children and adolescents. *Focus*, *14*(1), 34-45.

Thayer, Z. M., & Kuzawa, C. W. (2014). Early origins of health disparities: Material deprivation predicts maternal evening cortisol in pregnancy and offspring cortisol reactivity in the first few weeks of life. *American Journal of Human Biology, 26*(6), 723-730.

The Prime Minister's Youth Mental Health Project (2016). *Localities and National Perspectives Evaluation*. Wellington, N.Z.: Social Policy Evaluation and Research Unit. Available from: http://www.superu.govt.nz/ymh

Thomas, K. M., Drevets, W. C., Dahl, R. E., Ryan, N. D., Birmaher, B., Eccard, C. H., ... & Casey, B. J. (2001). Amygdala response to fearful faces in anxious and depressed children. *Archives of General Psychiatry*, *58*(11), 1057-1063.

Thornley, L., Ball, J., Signal, L. Lawson-Te Aho, K., & Rawson, E. (2013). Building community resilience: Learning from the Canterbury earthquakes: Final report to Health Research Council and Canterbury Medical Research Foundation. Available from: http://anzasw.org.nz/documents/0000/0000/0603/building-community-resilience-report.pdf

Thrupp, M. (2018, online 2017). *The Search for Better Educational Standards: A Cautionary Tale*. Springer.

Toth, S., Stronach, E., Rogosch, F., Caplan, R & Cicchetti, D. (2011). Illogical thinking and thought disorder in maltreated children. *Journal of the American Academy of Child and Adolescent Psychiatry, 50* (7), 659-668.

Tol, W., Barbui, C., Bisson, J., Cohen, J., Hijazi, Z, Jones, L. . . . & van Ommeren, M. (2014). World Health Organization guielines for management of acute stress, PTSD, and bereavement: Key challenges on the road ahead. *PLOS Medicine, 11*(2), 1-5. e1001769.

Tol, W. A., Komproe, I. H., Jordans, M. J., Ndayisaba, A., Ntamutumba, P., Sipsma, H., ... & de Jong, J. T. (2014). School-based mental health intervention for children in war-affected Burundi: a cluster randomized trial. *BMC Medicine*, *12*(1), 56.

Tottenham, N., & Sheridan, M. A. (2010). A review of adversity, the amygdala and the hippocampus: a consideration of developmental timing. *Frontiers in Human Neuroscience*, *3*, 68

Tranter, D. & Kerr, D. (2016). *Understanding self-regulation: Why stressed students struggle to learn.* Research monograph # 63. What Works: Research into Practice. Ontario, Canada: Ontario Association of Deans of Education and the Student Achievement Division. www.edu.gov.on.ca/eng/literacynumberacy/inspire/researchWhatWorks.html

Trauma-Informed Care in Behavioral Health Services (2014). Treatment Improvement Protocol (TIP) Series, No. 57. Center for Substance Abuse and Mental Health Services Administration Rockville, MD. https://www.ncbi.nlm.nih.gov/books/NBK207195/#part1_ch1.s5

Tremblay, R. E. (2010). Developmental origins of disruptive behaviour problems: the 'original sin'hypothesis, epigenetics and their consequences for prevention. *Journal of Child Psychology and Psychiatry*, *51*(4), 341-367.

Trickey, D., Siddaway, A. P., Meiser-Stedman, R., Serpell, L., & Field, A. P. (2012). A meta-analysis of risk factors for post-traumatic stress disorder in children and adolescents. *Clinical Psychology Review, 32*, 122-138.

Tucker, P., Pfefferbaum, B., North, C., Kent, A., Burgin, C., Parker, D . . & Trautman, R. (2007). Physiologic reactivity despite emotional resilience several years after direct exposure to terrorism. *American Jour. Psychiatry, 164* (2), 230-235.

Turcotte-Tremblay, A. M., Lim, R., Laplante, D. P., Kobzik, L., Brunet, A., & King, S. (2014). Prenatal maternal stress predicts childhood asthma in girls: Project Ice Storm. *BioMed Research International,* doi:http://dx.doi.org/10.1155/2014/201717.

Turnbull, G. J. (2006). The biology of post-traumatic stress disorder. *Psychiatry*, *5*(7), 221-224.

Turner-Cobb, J. (2013). The influence of prenatal exposure to stress. In *Child Health Psychology: A Biopsychosocial Perspective*, pp. 93-119. London: Sage Premier.

Udwin, O., Boyle, S., Yule, W., Bolton, D., & O'Ryan, D. (2000). Risk factors for long□term psychological effects of a disaster experienced in adolescence: predictors of Post Traumatic Stress Disorder. *Journal of Child Psychology and Psychiatry, 41*(8), 969-979..

U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. (2000). *Training manual for mental health and human services workers in major disasters, second edition*. Author: Washington, DC.

Usami, M., Iwadare, Y., Kodaira, M., Watanabe, K., Aoki, M., Katsumi, C., Matsuda, K., Makino, K., Iijima, S., Harada, M., Tanaka, H., Sasaki, Y., Tanaka, T., Ushijima, H. & Saito, K. (2012). Relationships between traumatic symptoms and environmental damage conditions among children 8 Months after the 2011 Japan Earthquake and Tsunami. *PLoS ONE, 7*, 50721.

Usami, M., Iwadare, Y., Watanabe, K., Kodaira, M., Ushijima, H., Tanaka, T., Hasasa, M., Tanaka, H., Sasaki, Y. & Saito, K. (2014). Analysis of changes in traumatic symptoms and daily life activity of children affected by the 2011 Japan earthquake and tsunami over time. *PloS One, 9(*2), e88885.

Valentine, J. & Wilson, O. (2002). *Classroom Acoustics- A New Zealand Perspective*. Auckland, NZ: The Oticon Foundation.

Van Ballegooy, S., Malan, P., Lacrosse, V., Jacka, M. E., Cubrinovski, M., Bray, J. D., O'Rourke, T., Crawford, S. & Cowan, H. (2014). Assessment of liquefaction-induced land damage for residential Christchurch. *Earthquake Spectra, 30*(1), 31-55.

van Beynan, M. (2015). Canterbury's months of earthquake innocence. The Press. http://www.stuff.co.nz/the-press/news/71669231/canterburys-months-of-earthquake-innocence; https://nzhistory.govt.nz/culture/canterbury-earthquake-september-2010-timeline; royal commission:van den Heuvel, L. L., & Seedat, S. (2013). Screening and diagnostic considerations in childhood post-traumatic stress disorder. *Neuropsychiatry, 3*(5), 497-511.

van den Heuvel, L. L., & Seedat, S. (2013). Screening and diagnostic considerations in childhood post-traumatic stress disorder. *Neuropsychiatry*, *3*(5), 497-511.

Van der Kolk, B. A. (1998). Trauma and memory. *Psychiatry and Clinical Neurosciences*, *52*(S1)-S64.

Van der Kolk, B. A. (2004). Psychobiology of posttraumatic stress disorder. *Textbook of Biological Psychiatry*, 319-344.

Van der Oord, S., Prins, P. J., Oosterlaan, J., & Emmelkamp, P. M. (2008). Efficacy of methylphenidate, psychosocial treatments and their combination in school-aged children with ADHD: a meta-analysis. *Clinical Psychology Review*, *28*(5), 783-800.

van Giezen, A. E., Arensman, E., Spinhoven, P. & Wolters, G. (2005). Consistency of memory for emotionally arousing events: A review of prospective and experimental studies. *Clinical Psychology Review, 25*(7), 935-953.

van Praag, H. (2002). The cognitive paradox in posttraumatic stress disorder: a hypothesis. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 28*, 923-935.

Verona, E., & Sullivan, E. A. (2008). Emotional catharsis and aggression revisited: heart rate reduction following aggressive responding. *Emotion*, *8*(3), 331.

Walder, D. J., Laplante, D. P., Sousa-Pires, A., Veru, F., Brunet, A., & King, S. (2014). Prenatal maternal stress predicts autism traits in 6½ year-old children: Project Ice Storm. *Psychiatry Research, 219* (2), 353-360.

Walker, S., Eketone, A., & Gibbs, A. (2006). An exploration of kaupapa Maori research, its principles, processes and applications. *International Journal of Social Research Methodology*, *9*(4), 331-344.

Wang, C. W., Chan, C. L., & Ho, R. T. (2013). Prevalence and trajectory of psychopathology among child and adolescent survivors of disasters: a systematic review of epidemiological studies across 1987–2011. *Social Psychiatry and Psychiatric Epidemiology, 48*(11), 1697-1720.

Ward, J. & Thomas, G. (2016). *National standards: School Sample Monnitoring & Evaluation Project, 2010-2014*. Wellington: Ministry of Education.

Warwick, H., Reardon, T., Cooper, P., Murayama, K., Reynolds, S., Wilson, C., & Creswell, C. (2017). Complete recovery from anxiety disorders following Cognitive Behavior Therapy in children and adolescents: A meta-analysis. *Clinical Psychology Review*, *52*, 77-91.

Watkins, T. (08.03.2011). Over 10,000 earthquake damaged homes may be lost. *The Christchurch Press.*

Wechsler D. (2006). *Wechsler Intelligence Scale for Children-Fourth edition- Australian standard edition*. Sydney, Australia: Harcourt Assessment.

Weems, C. F. (2015). Biological correlates of child and adolescent responses to disaster exposure: A bio-ecological model. *Current Psychiatry Reports*, *17*(7), 1-7.

Weems, C. F., & Graham, R. A. (2014). Resilience and trajectories of posttraumatic stress among youth exposed to disaster. *Journal of Child and Adolescent Psychopharmacology*, *24*(1), 2-8.

Weems, C. F., Scott, B. G., Taylor, L. K., Cannon, M. F., Romano, D. M. & Perry, A. M. (2013). A theoretical model of continuity in anxiety and links to academic achievement in disaster-exposed school children. *Development and Psychopathology, 25*(03), 729-737.

Weiss, D. & Marmar, C. (1997). The Impact of Events Scale – revised. In. J.P. Wilson & T.M Keane (Eds.), *Assessing psychological trauma and PTSD: A handbook for practitioners,* pp. 399–411. New York: Guilford Press.

Wells, A. (2005). Detached mindfulness in cognitive therapy: A metacognitive analysis and ten techniques. *Journal of Rational-Emotive and Cognitive-Behavior Therapy*, *23*(4), 337-355.

Wells, J. E. (2009). Comparisons of the 2007 national survey of mental health and well-being and the 2003–2004 New Zealand mental health survey. *Australian and New Zealand Journal of Psychiatry, 43*(7), 585-590.

Wesnes, K. A., Pincock, C., & Scholey, A. (2012). Breakfast is associated with enhanced cognitive function in schoolchildren. An internet based study. *Appetite*, *59*(3), 646-649.

Wesnes, K. A., Pincock, C., Richardson, D., Helm, G., & Hails, S. (2003). Breakfast reduces declines in attention and memory over the morning in schoolchildren. *Appetite*, *41*(3), 329-331.

Widenhorn-Müller, K., Hille, K., Klenk, J., & Weiland, U. (2008). Influence of having breakfast on cognitive performance and mood in 13-to 20-year-old high school students: results of a crossover trial. *Pediatrics*, *122*(2), 279-284.

Widyatmoko, C. S., Tan, E. T., Seyle, D. C., Mayawati, E. H., & Silver, R. C. (2011). Coping with natural disasters in Yogyakarta, Indonesia: The psychological state of elementary school children as assessed by their teachers. *School Psychology International*, *32*(5), 484-497.

Williamson, V., Creswell, C., Fearon, P., Hiller, R. M., Walker, J., & Halligan, S. L. (2017). The role of parenting behaviors in childhood post-traumatic stress disorder: A meta-analytic review. *Clinical Psychology Review, 53*, 1-13.

Winslow, E., Sandler, I. Wolchik & Carr, C. (2014). Building resilence in all children: A public health approach. pp. 459-480. In. S. Goldstein & R. Brooks (Eds). *Handbook of Resilience in Children*. Springer. 459-480.

Winterbottom, M., & Wilkins, A. (2009). Lighting and discomfort in the classroom. *Journal of Environmental Psychology*, *29*(1), 63-75.

Wood, A. (2013, Sep 9). Quakes led people to quit jobs-research. http://www.stuff.co.nz/the-press/news/christchurch-earthquake-2011/9144628/Quakes-led-people-to-quit-jobs-research

Woolf, S. H., Purnell, J. Q., Simon, S. M., Zimmerman, E. B., Camberos, G. J., Haley, A., & Fields, R. P. (2015). Translating evidence into population health improvement: strategies and barriers. *Annual Review of Public Health*, *36*, 463-482.

World Health Organization (n.d.). *WHO-Five Well-being Index* (WHO-5). Available from: http://www.psykiatri-regionh.dk/who5/menu/

World Health Organization. (2014). *Social determinants of mental health*. World Health Organization. http://apps.who.int/iris/bitstream/10665/112828/1/9789241506809_eng.pdf

World Health Organization (WHO) (2017). Constitution: *Principles of health.*. Available from: http://www.who.int/about/mission/en/

Wright, M., 2012, Oct 8). 10,600 people leave Christchurch. The Christchurch Press. http://www.stuff.co.nz/the-press/news/7783450/10-600-people-leave-Christchurch

Wright, M. (2016, Oct 18). Canterbury records most suicides in New Zealand. The Christchurch Press. http://www.stuff.co.nz/the-press/news/85452513/canterbury-records-most-suicides-in-new-zealand

Wylie, C., & Hodgen, E. (2005). *Stress and well-being among New Zealand principals: Report to the New Zealand Principals' Federation*. *NZCER* 3, http://www.nzcer.org.nz/research/publications/stress-and-well-being-among-new-zealand-principals-report-new-zealand-principa?cPath=130_131&products_id=1555

Ying, L-H., Wu, X-C., & Lin, C-D. (2012). Longitudinal linkages between depressive and posttraumatic stress symptoms in adolescent survivors following the Wenchuan earthquake in China: A three-wave, cross-lagged study. *School Psychology International, 33*(4), 416-432.

Yoshizaki, T., Tada, Y., Hida, A., Sunami, A., Yokoyama, Y., Togo, F., & Kawano, Y. (2013). Influence of dietary behavior on the circadian rhythm of the autonomic nervous system as assessed by heart rate variability. *Physiology & Behavior*, *118*, 122-128.

Yule, W., Bolton, D., Udwin, O., Boyle, S., O'Ryan, D., & Nurrish, J. (2000). The long-term psychological effects of a disaster experienced in adolescence: I: The incidence and course of PTSD. *Journal of Child Psychology and Psychiatry*, *41*(4), 503-511.

Young, H. A., Johnston, S., & Benton, D. (2017). Compensatory Autonomic Modulations Mediate Hypohydration Related Changes in Brain Functioning and Mood. *The FASEB Journal*, *31*(1 Supplement), 298-3.

Zakszeski, B. N., Ventresco, N. E., & Jaffe, A. R. (2017). Promoting resilience through trauma-focused practices: A critical review of school-based implementation. *School Mental Health*, *9*(4), 310-321.

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools—a systematic review and meta-analysis. *Frontiers in psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00603

Zhang, J., Zhu, S., Du, C., & Zhang, Y. (2015). Posttraumatic stress disorder and somatic symptoms among child and adolescent survivors following the Lushan earthquake in China: A six-month longitudinal study. *Journal of psychosomatic research*, *79*(2), 100-106.

Zhang, Y., Zhang, J., Zhu, S., Du, C., & Zhang, W. (2015). Prevalence and predictors of somatic symptoms among child and adolescents with probable posttraumatic stress disorder: a cross-sectional study conducted in 21 primary and secondary schools after an earthquake. *PloS One, 10*(9), e0137101.

Zhu, X., Suarez-Jimenez, B., Helpman, L., Markowitz, J., Papini, S., Durosky, A., ... & Neria, Y. (2017). 237. PTSD exposure-based treatment changes amygdala and hippocampus resting state functional connectivity in PTSD. *Biological Psychiatry*, *81*(10), S97-S98.

Zilberstein, K. (2014). Neurocognitive considerations in the treatment of attachment and complex trauma in children. *Clinical Child Psychology and Psychiatry*, *19*(3), 336-354.

Zill N. (1985). *Behavior Problem Scales Developed From the 1981 Child Health Supplement to the National Health Interview Survey.* Washington, DC: Child Trends.

Zuj, D. V., Palmer, M. A., Gray, K. E., Hsu, C. M. K., Nicholson, E. L., Malhi, G. S., ... & Felmingham, K. L. (2017). Negative appraisals and fear extinction are independently related to PTSD symptoms. *Journal of Affective Disorders*, *217*, 246-251.

Sources of Information for Table i.1

Hurricane Katrina: http://www.ncbi.nlm.nih.gov/pubmed/18756175; http://www.cbpp.org/cms/?fa=view&id=658

Chch poverty, 22% http://www.occ.org.nz/home/childpoverty/about_child_poverty 2007

Japan injuries source: http://www.britannica.com/EBchecked/topic/1761942/Japan-earthquake-and-tsunami-of-2011

Pre-disaster population in Japan: http://tohokugeo.jp/disaster/articles/e-contents16.html

Population, cost, damage to buildings, injuries, deaths by agehttp://earthquake-report.com/2012/03/10/japan-366-days-after-the-quake-19000-lives-lost-1-2-million-buildings-damaged-574-billion/

Poverty rate for children in Japan: http://www.unicef-irc.org/publications/pdf/rc10_eng.pdf

Poverty rate for population (2010): https://www.cia.gov/library/publications/the-world-factbook/fields/2046.html

Appendix 1

Emotion Coaching

When a child is reacting to stress, they are not ready to learn. They need your support and understanding. Helping them to communicate what they are feeling is a good way to provide support.

Once children are able to recognise when they are stressed, they are more likely to be able to learn self-regulating strategies and to recognise when other children may be stressed. As children learn to regulate and understand their own emotions, they will develop self-confidence. Helping children learn what their emotions are is needed for them to develop self-regulation of their emotions.

One reason children become irritable, angry, withdrawn or clingy is that they may not understand what they are feeling inside.

The steps explained here should help your child learn about their inside feelings, and to recognise when they are stressed. This will help them develop self-regulation.

Be aware that children who are sensitive to stress may have difficulties remembering what they have learned, so be patient. Learning takes time and needs to occur when a child is calm.

How are Feelings Different From Emotions?

We may use the words 'feelings' and 'emotions' to mean the same thing in our casual day-to-day speech, but these actually arise from very different parts of the brain.

Environmental stimuli cause biological changes in the brain and produces biological changes in the body. These changes are emotions. For example, the eyes perceive a person approaching in a threatening manner holding a knife. The amygdala interprets the threat. Heart-rate increases and other biological changes take place. The emotion of fear is felt.

These changes in the sub-cortical regions of the brain are emotions. The amygdala releases neurotransmitters, which seem to trigger the memory of the emotions—so we have strong memories associated with emotions (and this contributes to the persistence of PTSD).

Emotions are thus 'reactive' physical responses to events that occur, and also produce physical reactions. For instance, fear is associated with the four F's: fright, flight, fight or freeze.

Feelings are mental associations our meaning-making brain constructs about the emotions we have. Emotions are strong, physical reactions.

Feelings are more transient and come from a different part of the brain. Feelings are mental representations of how our body is experiencing the physical experiences of the emotion.

It is important to remember that stress can create many changes in the body. Here is a partial list.....

1. they are dizzy
2. their tummy is upset
3. their head is hurting,
4. they can't sleep at night,
5. they wake up and their heart is pounding
6. they have nightmares;
7. they feel hot (or cold and clammy),
8. they may feel they need to go to the toilet but when they do nothing happens, or they find that they have wet themselves and they can't understand why,
9. breathing can become rapid
10. they can feel light-headed or dizzy and not understand why,
11. they may feel it is hard to concentrate sometimes, but other times they can
12. their muscles can tense up;
13. they can have trouble remembering
14. they can find themselves saying things over and over without understanding why;
15. t hey can start crying and there is no reason they can explain
16. also, there may be nail-biting, diarrhoea or constipation, wanting a dummy, and so forth when they are school age

Learning about "Calm" and "Stressed"

Although there are many many emotions, the first step is to help the child learn the difference between stressed or overloaded and calm. This is the most important first step learning to assist the child in developing self-regulation.

Cards with images to depict emotions are used to help the child visualise the emotion and also to aid memory. They are also useful prompts for teachers and parents to remember the steps in coaching emotions (especially if the steps are copied onto the back of the cards).

Stressed children are often deserted by their language, and so pictures are a handy means of communicating – and picture cards can be used during crying, meltdowns or anger bursts in a calm way. You can ask your child to draw cards or make up your own.

You will need at least two sets of cards. One for yourself and one for the child. You may also want to have a set of cards in the kitchen, car, or other location where they will be handy if needed. Keep these two sets of cards close by – accessible to both your child and you (on the bench, for example, or in your pocket).

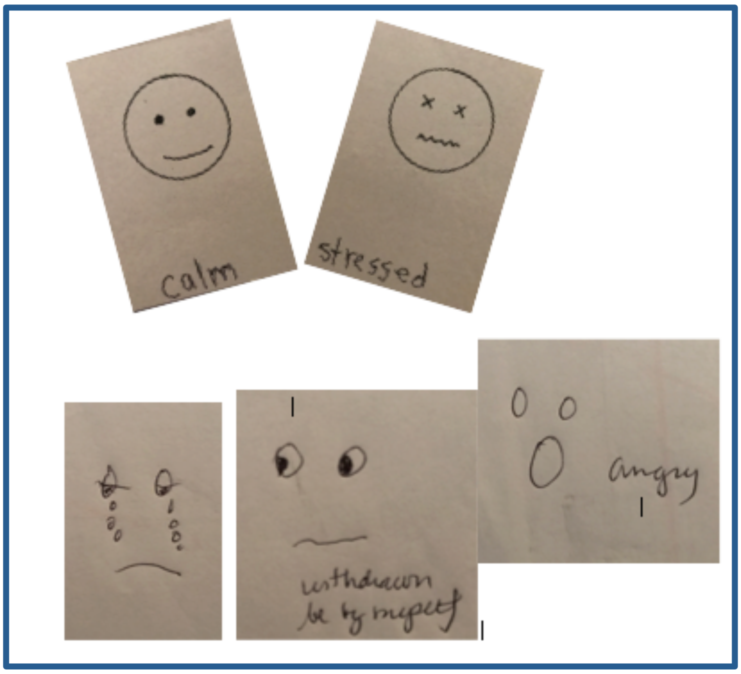

Figure A-1: The emotion coaching cards I started with are at the top of the figure. When these cards were shown to a ten-year-old girl , she quickly responded by drawing how she experienced stress (from left to right: sad, wanting to be by myself, and angry).

Immediate Help for a Stress-Overwhelmed Child

Stress attacks can happen to even the most-self-regulated children, but these children are more likely to have successful ways of calming themselves. A child who often has stress-attacks is likely finding it very hard to calm themself down.

The research on resilience in vulnerable children in New Zealand studied adults who had experienced several traumatic events in childhood, including sexual, physical, and emotional maltreatment, multiple household moves, and poverty. This research identified that only four in ten children who experienced multiple traumatic events (40%) achieved positive outcomes, such as finishing secondary school. (This is half as many for children with fewer or no traumatic events). However, in depth-interviews with those that did have positive outcomes identified that “Positive, supportive relationships are key to facilitating resilience” and the younger the age at which these can be established, the better for positive outcomes (Social Policy Research Unit, 2017).

It is with the aim of maintaining and supporting positive relationships between teachers and pupils, and between parents and children, and to build stress resilience that the following strategies are recommended.

AIM: Create a calm space and support the child to calm down.

How to Help

When a child is reacting to stress, remember:

They are not doing this to get attention or to get out of doing something. They are not 'doing this on purpose'. Their bodies are reacting to feelings, memories, fear, noises, lights and other things differently to how your body reacts.

Stay calm yourself: calm conveys strength. You can be an excellent role model!

Do not take the child's emotional behaviour personally. They are stressed out and feel terrible inside. No one likes to feel like that.

Give reassurance and affection. These are the first steps in helping your child calm down.

Explain to them what is going on: "You seem to be feeling stressed/frustrated/upset/overwhelmed". (Don't be surprised if they react angrily to this statement. This is because the first times the feelings/behaviours are named may cause more stress – the stress associated with learning things about yourself). In the long term, however, using such words helps children to put words to their feelings.

Show you understand by saying that you, too, have felt upset. It is even better if you can say something like this: "Anyone would feel upset if they lost their sunhat/forgot their homework/were called a name/etc." This is important as it normalises their feelings to them. Research has shown that it is helpful for children to learn that other people can also feel like they do. Understanding their feelings, and having these feelings understood and accepted by others, is an important step in learning self-regulation.

Saying this in a soothing voice can help them to calm down.

Suggest a positive (alternative) way to help calm down, and be explicit as to why this activity is suggested. For example, "When you feel better, let's sit down and look at a picture book/colour in a mandala with pencils. Looking at pictures/using pencils to colour in a mandala can help some children feel better, and you might find this helps you. [Be sure to follow through on your promise to be with them.]

<u>Helping Reactive Coping</u>

The goal of helping a child who is reactively coping is to ensure that they feel accepted, even though their behaviour is difficult for others. Punishing or chastising the child for behaviour they can't control at the moment will not be effective at helping the child learn how to cope.

If the overwhelmed child is engaged in behaviour that might harm others, move the other children to safety, or send them to the library or another classroom (this can be arranged ahead of time). This can be done quietly, and with an explanation that helps the other children understand what is happening but that does not stigmatise the struggling child. For example, "Please go to the library. I need to help Chris right now." A calm tone of voice will be reassuring for everyone and is a model of adult self-regulation in the presence of a stressor.

It is best to judge how best to help by using your knowledge of the struggling child. Trying to talk to an overwhelmed child is likely to be ineffective, as their language processing and listening skills are likely to be affected by the stress hormones. Instead, think of an alternative activity that might assist the child's body to dissipate the stress. For example:

Hold their hands and jump up and down as long as you can. Smile. Sing a song. Count to 10 yourself as you are jumping. If this ends in laughing and tickling, so much the better!

Put on some happy music and dance 'till you both drop!

These types of activities will help the body get rid of some of the toxic hormones like cortisol that might flood the child's body during a stress attack.

Most importantly, you being there will help the child feel safe and reassured.

Helping Dependent Coping

Children with dependent coping need the help of an adult to calm down. Instead of a 'fight' response, dependent coping can be interpreted as a 'fright' response. If the child were able to calm him/herself, he/she would do it, as children naturally like to become independent as they grow up. Dependent coping can also be considered as a reversion to a younger child's coping skills, or it can be regarded as the same type of coping adults can do when they are feeling overloaded with stress. Adults, too, can cry and reach out to others for support. So, the strategies for children who are using dependent coping actually involve providing comfort. Below are some suggestions as to how to do this, but knowledge of the child will help determine the best form of support to provide.

Sit with them and read them a story using a whisper voice or quietly look at pictures in the book.

Listen to quiet music

Sit with them while they colour in (use pencils, as making a mistake that can't be corrected that can happen when using felts or crayons can create stress).

Help them find a soft toy to cuddle while you cuddle them (they're not too old).

Use emotion coaching when they are calm (see Appendix 1).

Helping Withdrawal Coping

Children who withdraw are actually responding to a signal from their brain – the signal that there might be something to fear or a new set of stressors in the environment. Rather than fight or fright, this response can be considered a "freeze" response. This reactive response is designed to protect the emotional centres of the brain from additional stimuli. Adults, too, use withdrawal. Think of the adults who 'go for a run' or 'zone out' in front of a screen and want to be left alone – all of these are examples of the ways that adults use a form of 'withdrawal' coping when they feel overwhelmed by stress. It's just that age and experience have provided the adults with socially acceptable ways to withdraw. For children who have withdrawn, they need space and time for their body's reactions to dissipate.

Give them time to think.

They are needing to be alone

Follow their lead when they decide to join in, but don't force them to (this only increases the stress).

Avoid Doing These Things

The following reactions to child stress can make stress worse and behaviour more extreme. These types of reactions communicate to the child that their body's emotional reaction to stress is inappropriate or wrong without helping them learn appropriate coping (and since they are overwhelmed with stress in the moment, they are not in a position to be able to learn). Negative responses can confuse them, which increases the stress, and does not help them

learn self-regulation. It also makes the child, who is in a negative stressed space at the moment, perceive the person who administers these consequences as a threat and negative stressor in their lives. It is difficult for children to learn from someone who treats them adversely when they are stressed.

Similarly, an adult who reached out to others for help and found the phone call terminated with a reprimand ("Don't bother me when you're so upset") might equally find their feelings turning negative toward the person who delivered the reprimand. Likewise, if the adult had retreated to their bedroom for some quiet space, and were then dragged out and told to get to work on the dinner, they might feel angry and upset that their quiet time had been disrespected. Those who express their stress in angry reactions become even angrier when they are reprimanded for their behaviour. Trying to teach someone coping skills or control their 'behaviour' with contingency management in this situation is not going to be effective, and will instead increase the child's stress and extend the period of immediate difficulty. These effects of

Do not:

Punish, put in timeout, or reprimand the child for their attempts to cope.

Ignore the child or pretend its not happening.

Reject/push the child away or tell them to "stop being such a baby".

Make the child join in or play with the other children/family when they don't want to.

Ask the child to explain their behaviour, as they may not have the words to explain their feelings.

Expect that stressed children are able to understand what is happening in their bodies.

Tell the child to 'Get over it'.

Say things like, "It's about time you stopped that and settled down."

Show frustration or anger in your tone or facial expression, as the child may pick up on this and this could increase their stress.

Children cannot learn self-regulation if they are stressed, punished, ashamed or bewildered.

Children who are stressed are not in a mental state for learning, for self-regulation or for sleeping. If they knew how to control their stress, they would be doing it. No one likes to feel out of control.

Longer Term Strategies to Help Children Learn Self-Regulation

Based on numerous research studies cited in other chapters in this book, there are three long-term strategies that are recommended to help children learn self-regulation. These include Emotion- coaching and Omega-3 Diet Supplementation, explained in Appendices in this book. In addition, sleep and other somatic issues that often accompany stress also need to be addressed, as children who have sleep problems and health-related issues will have difficulties with self-regulation. These issues will be covered in a subsequent edition of this book.

The New Zealand Ministry of Education (n.d.): Anticipating and responding to child stress (excerpt)

Children and young people can start acting out when there are other stresses in their lives. Reassuring the child or young person and providing extra care may help to get them through these stressful times. But if they don't feel better and their behaviour doesn't improve, seek professional help, particularly if the behaviour lasts many months or is severe.

If you know the children and young people in your centre or class well, it's sometimes possible to observe they may be frustrated, stressed, or anxious. Look for some of the signs mentioned below and get in early. Make a point of understanding particular stressors for children and young people with special education needs, such as certain types of noise, changes in routines, pain, or discomfort.

Remember, children and young people can express feelings outwardly or internalise them. Pay attention to unusually quiet behaviour as well as 'loud' exhibitions of behaviour.

Look for signs that things may not be quite right:

- _increase in movement and noise
- _talking faster and louder
- _irritability or being overly emotional
- _not complying
- _head down, quiet, and overly compliant
- _withdrawing socially and avoiding eye contact
- _toileting or eating concerns
- _headaches or stomach aches
- _smiling and laughing inappropriately
- _not concentrating
- _unexplained fears or increased anxiety (can take the form of clinging)
- _experimenting with drugs/alcohol
- _falling marks.

What's Wrong with Time Out for Children

by Dr. Laura Markham, founder of

AhaParenting.com[16]

It's true that timeouts for children are infinitely better than hitting, and yelling. But Timeouts teach the wrong lessons, and they don't work to create better behaved children. In fact, they always worsen kids' behavior.

Why? Because any child can explain to you that timeouts ARE punishment, not any different than when you were made to stand in the corner as a child. And any time you punish a child, you make him feel worse about himself.

Here's what happens when you use timeouts for children:

1. Timeouts make kids feel bad about themselves. You confirm what she suspected – she is a bad person. Not only does this lower self esteem, it creates bad behavior, because people who feel bad about themselves behave badly.

As Otto Weininger, Ph.D. author of Time-In Parenting says:
"Sending children away to get control of their anger perpetuates the feeling of 'badness" inside them…Chances are they were already feeling not very good about themselves before the outburst and the isolation just serves to confirm in their own minds that they were right."

2. Kids need our help to learn to calm themselves. Sure, a child will eventually calm down if confined to "the naughty step" or their room, but what they'll be learning is that they are all alone with their most difficult feelings and problems. The fastest way to teach kids to calm themselves is to provide a "holding environment" for the child, giving him the message that his out of control feelings are acceptable and can be managed.

3. You're breaking your child's trust in you by triggering his fear of abandonment. Banishing an upset child is pushing him away just when he needs you the most. Worst of all, instead of helping him to calm down, it triggers his innate fear of abandonment. If gives him the message that only his "pleasant" feelings are ok, that his authentic, messy, difficult feelings – part of who we all are – are unacceptable and unlovable.

4. Instead of reaffirming your relationship with your child so she WANTS to please you, timeouts create a power struggle. They set up a relationship that pits you and your authority against the child. It's true that as long as the parent is bigger than the child, the parent wins this power struggle, but no one ever really wins in a parent-child power struggle. The child loses face and has plenty of time to sit around fantasizing revenge. (Did you really think she was resolving to be a better kid?).

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[16] Used with permission of Dr. Laura Markham, founder of AhaParenting.com and author of Peaceful Parent, Happy Kids: *How To Stop Yelling and Start Connecting* and Peaceful Parent, Happy Siblings: *How to Stop the Fighting and Raise Friends for Life*

Another version of the article can also be found here: http://www.ahaparenting.com/Default.aspx?PageID=7652647&A=SearchResult&SearchID=10432535&ObjectID=7652647&ObjectType=1

5. Because you have to harden your heart to your child's distress during the timeout, timeouts erode your empathy for your child. Yet your empathy for this struggling little person is the basis of your relationship with him, and is the most important factor in whether or not he behaves to begin with. So parents who use timeouts often find themselves in a cycle of escalating misbehavior.

So timeouts for children, while infinitely better than hitting, are just another version of punishment by banishment and humiliation. To the degree that Timeouts are seen as punishment by kids – and they always are — they are not as effective as positive discipline to encourage good behavior.

So if you're using them as punishment for transgressions, that's a signal that you need to come up with a more effective strategy.

And if you're using them to deal with your kids' meltdown, that's actually destructive, as I mentioned, because you're triggering your child's abandonment panic.

If you want to teach your child emotional self-management, that's only effective before a meltdown starts.

When you realize your child is getting to that dangerous over-wrought place, suggest that the two of you take some "cozy time" – snuggle up and read a book. Some parents call this a "Time IN" because it signals to the child that this is a time to experience his emotions, so he can let them go and move on.

Once the meltdown starts and your child is swept with emotion, it's too late for teaching. Just stay nearby so you don't trigger his abandonment panic, and stay calm. Don't give in to whatever caused the meltdown, but offer your total sympathy and be ready to reassure him of your love.

I want to add that Timeouts for adults are a terrific management technique for keeping your own emotions regulated. When you find yourself losing it, take five. This keeps you from doing anything you'll be sorry about later. It models wonderful self-management for your kids. And it ultimately makes your discipline more effective because you aren't making threats you won't carry out.

Parents who use timeouts are often shocked to learn that there are families who never hit, never use timeouts, and rarely raise their voices to their children. But you shouldn't need to use these methods of discipline, and if you're using them now, you'll probably be quite relieved to hear that you can wean yourself away from them.

Additional information about Time Out

Lamia, M. (2016). *Why time-outs need a time out*. Psychology Today, Health Profs.com. Available on https://www.psychologytoday.com/blog/intense-emotions-and-strong-feelings/201606/why-time-outs-need-time-out

Russell, W. (2016). *Why you should never use timeouts on your kids*. Public Broadcasting Network http://www.pbs.org/newshour/updates/column-why-you-should-never-use-timeouts-on-your-kids/

Siegel, D. & Bryson, T. (2014). *'Time-outs" are hurting your child.* Time.com, http://time.com/3404701/discipline-time-out-is-not-good/

How to get started with Emotion Coaching

Step 1: Introduce the emotion coaching cards

Find a time when the child is calm and definitely not stressed. Explain the cards to your child who might be sensitive to stress. For example:

This card is for when you are feeling stressed INSIDE and this card is for when you are feeling calm and settled INSIDE.

Step 2: Help the child learn the relationships between how they feel inside and their behaviours on the outside

Feeling stressed

If you find your child acting (outside) irritable, angry, aggressive, clingy, or any other sign of being stressed, say to them gently (be gentle, you don't want to increase their stress)

You are (acting angry / You are looking upset/ You are looking hot/You are looking very worried/ or something from the list on stress). This means that you are probably feeling stressed inside.
This step involves telling the child that something they are doing (something on the outside), is communicating their feelings.

However, as how they actually feel on the inside is not known, it is important to say that this may be / probably is/ how they are feeling. It is important to give a normal everyday label to what the child might be feeling.

If the child immediately disagrees with what is inferred (No I am not upset!!), the best thing to do is to APOLOGISE and ask. *"Oh, I'm sorry!! Can you tell me how you are feeling?"*

Point to the stressed/calm card or give the stressed/calm card to your child and, say *Feeling stressed is ok, everyone gets stressed, but no one wants to feel like that inside.* This is a key ingredient. The child needs to know that everyone feels stress at some times. This normalises their perceptions of themselves. Some children have later said that they felt like they were "bursting like a volcano" or like "my brain is on fire" inside, and this made them really worried or scared that they were 'going crazy' or becoming a 'crazy person.', Telling them that everyone feels stressed like that inside at times helps reassure them that what they are feeling is normal.

Remember, children of this age are "concrete thinkers' and can not necessarily accurately understand or perceive the feelings of others. I

Children who have experienced significant stress are also likely to be more attuned to negative perceptions, fears and emotions. They might tend to see everything as a catastrophe. So, their own feelings, especially when they don't understand them, will be even more fright-making. So, don't forget this step!

Next, say "*I will help you calm down"* or "*Do you want me to help you calm down"* or "*Can you try to calm down by yourself?*" (point to calm card and use one of the strategies for

calming down after stress explained below).

Ask the child to give you the "Calm" card when they are feeling calm inside.

You can also encourage the child to give you the stressed card when they are feeling stressed. Then you can acknowledge that they are stressed, and that they are learning to recognise this themselves!

Feeling calm

When the child shows you the calm card, or you notice that the child is calm. "*You are feeling calm!* (give card or check that child agrees with you) *Let's play, or read, or sit and talk! (*Children are not able to play well, or to learn when stressed).

<u>Step 3: Learning Self-regulation / Better coping skills</u>

When the child is calm and alert, talk to them about ways they can calm down, and help the child try to identify these themselves. What can help children calm down? Here are some strategies that have been successful:

1. Being soothed by an adult
2. Being left alone for a few minutes in a safe place.
3. A favourite blanket or soft toy.
4. Go to a safe, quiet place.
5. Think about a safe, quiet place (Nana's lap).
6. Listen to music on earphones.
7. Jump up and down.
8. Run around outside.
9. Fill in a mandala with coloured pencils.
10. Take three deep breaths.
11. Counting to ten.

Explain to the child that they can access the object, place or event that will help them calm themselves whenever they need to calm down.

The child's recognition that they need to put a new coping strategy in place is a necessary and important step to develop self-regulation.

Children will need to learn to use the new strategies over time. This is because they must teach the brain not to be reactive. Take, for example, the child who bursts into tears when they become overwhelmed with stress, as shown in Figure A-1. There are twice as many steps requiring mental effort to put the new strategy into place as in reverting to the old strategy. Changing is difficult and requires time and patience!

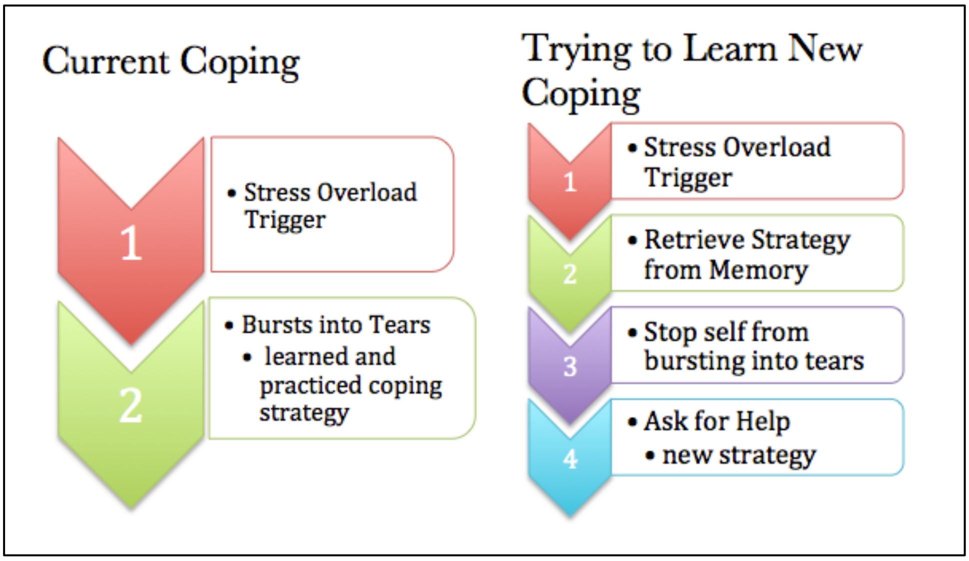

Figure A-1. Trying to learn a new coping skill requires a lot more effort than a frequently used one.

"Taking Advantage"

Parents and teachers can sometimes feel that the child will 'take advantage' and use going to 'the calming place' or access to the 'calm down soft toy' to avoid doing their schoolwork, or going to bed, for example. The child might actually use the calming strategies frequently, but this is not because they are "taking advantage", it is because they are actually stressed.

How do we know? Research consistently points out that children love to learn and are thirsty for new knowledge and skills, as long as the learning is set at the appropriate level. They also want desperately for the parent to approve of and love them. If children are repeatedly going to their 'calm' place instead of learning or instead of staying with their family, they are communicating that the material is too difficult, or that there is another source of stress (even one that can't be seen in the immediate environment), and they are not able to cope with the present moment.

For teachers, children who are stressed have difficulty learning and remembering what they are taught, so it might well be that they find the learning situation stressful and seek to avoid it. There are steps that can be taken to reduce the stress of the learning situation. For instance, give the child easier material to work with, and let them have the opportunity to succeed. Then build up the challenge gradually and slowly, so that the child has less stressful experiences with the content. As the child experiences success

Being an ‘emotion’ model

You can also use the cards yourself to model calming yourself down. You can say: I feel stressed (take the stressed card) (But only if this is true, don’t pretend, as it will be confusing). I am going to walk around in the garden until I feel calm. (Walk around the garden, come in with a calm face, point to the calm card and explain, “I feel better inside, I feel calm”—But only if this is actually true!!

For More Information About Emotion Coaching

Ellis, B. H., & Alisic, E. (2013). Maternal emotion coaching: A protective factor for traumatized children's emotion regulation?. *Journal of Child & Adolescent Trauma*, *6*(2), 118-125.

Ellis, B. H., Alisic, E., Reiss, A., Dishion, T., & Fisher, P. A. (2013). Emotion regulation among preschoolers on a continuum of risk: The role of maternal emotion coaching. *Journal of Child and Family Studies*, *23*(6), 965-974.

Macklem, G. L. (2008). Strategies for Parents and Teachers. In *Practitioner’s Guide to Emotion Regulation in School-Aged Children* (pp. 123-142). Springer US. A preview of the contents of this book may be found here: https://download.e-bookshelf.de/download/0000/0021/85/L-G-0000002185-0002367720.pdf

The Centre on the Social and Emotional Foundations of Learning (n.d.) teaching your child to: Identify and express emotions. Vanderbilt University. Available from: http://csefel.vanderbilt.edu/resources/family.html

Appendix 2

Omega 3- Diet Supplementation

Diet supplementation with child Omega 3, available over the counter, is a strategy that can be implemented alongside other strategies to help children recover from some of the effects of chronic stress. In this Appendix, the reasons for this recommendation are explained, and key international research evidence for this recommendation is presented.

Diet supplementation can be a contentious issue, and the decision to recommend diet supplementation for very stressed children is not one to be taken lightly.

Some types of Omega 3 may be helpful to children who have problems that may be related to previous exposure to stress. These include sleeping problems, wetting the bed, headaches, and even having difficulty coping with change. Some children may also have behaviour problems. According to this research, the dietary supplement ***Nutralife Smart Bites***[17] Omega-3 from fish can be effective in reducing behaviour problems and stress symptoms if taken for 6 months or more.

This product can be purchased over the counter in New Zealand—no prescription is required. It has been tested to ensure that it does not contain harmful heavy metals, such as mercury, that can be found in fish.

The brick wall theory

In a story about parents who advocated for omega 3 to treat their critically brain-injured son, CNN described the brick wall theory.

“The theory behind using omega-3 fatty acids to heal brain injury: the human brain, which itself is a fatty mass, is about 30% composed of omega-3 fatty acids, according to Lewis [the family GP]. In his words, high doses of omega-3 fatty acids, since they mirror what is already in the brain, could facilitate the brain's own natural healing process.

"It really gets down to what I would call my brick wall analogy," Lewis said. "If you have a brick wall and it gets damaged, wouldn't you want to use bricks to repair the wall? And omega-3 fatty acids are literally the bricks of the cell wall in the brain."[18]

Omega 3 References and Abstracts

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[17] No one in the project has any connection to this product.

[18] Smith, S. (January 17, 2017). “Fish oil helped save our son.” CNN. http://edition.cnn.com/2012/10/19/health/fish-oil-brain-injuries/index.html

Citation: L. Eugene Arnold, Fish Oil Is Not Snake Oil, *Journal of the American Academy of Child & Adolescent Psychiatry*, Volume 50, Issue 10, October 2011, Pages 969-971, ISSN 0890-8567, http://dx.doi.org/10.1016/j.jaac.2011.07.012. [19]
(http://www.sciencedirect.com/science/article/pii/S0890856711006423)

*A treatment that is safe, easy, cheap, and sensible in light of other knowledge does not need as much evidence to justify trying it as does a treatment that is risky, unrealistic, difficult, or expensive.

*omega-3 supplementation is safer than Food and Drug Administration-approved medication.

• Whatever product is used, it should be free of mercury. This is designated on the label by “mercury-free,” “refined to eliminate mercury,” or “USP.”

• Most studies reviewed by Bloch and Qawasmi used a daily dose found in approximately 1 to 2 g of fish or other marine oil (some used less). More than 2 g of marine oil might be better, but that has not been established.

• The studies demonstrating benefit generally were at least 3 months. Counsel patience and prepare the family to adhere for 3 months.

• Background micronutrients should be assured by a truly balanced diet, including vegetables, whole grains, dairy, fruit, and meat, or a multivitamin/mineral in the recommended daily amount.

New Zealand Recommended Standards For Intake

National Health and Medical Research Council, Australian Government Department of Health and Ageing, New Zealand Ministry of Health. (2016). *Nutrient Reference Values for Australia and New Zealand*. Canberra: National Health and Medical Research Council; 2006; Version 1.1, March, 2017. Downloaded 19.6.2017

https://www.nhmrc.gov.au/_files_nhmrc/file/publications/17122_nhmrc_nrv_update-dietary_intakes-web.pdf

“A second group of n-3 fatty acids are the long chain (LC) acids eicosapentaenoic acid (EPA, 20:5), docosahexaenoic acid (DHA, 22:6) and docosapentaenoic acid (DPA, 22:5) that are found predominantly in oily fish such as mackerel, herrings, sardines, salmon and tuna and other seafood. Whilst α-linolenic acid predominates in western diets, the fish oils, DHA, EPA and DPA predominate in other communities consuming their traditional diet, such as the Inuit “ p. 31.

“DHA plays an important role as a structural membrane lipids, particularly in nerve tissue and the retina, and can also act as a precursor to certain eicosanoids. EPA is the precursor of the 3 series of prostaglandins and the 5 series of leukotrienes. In recent years, research has shown both cardiovascular and anti-inflammatory benefits of LC n-3 fatty acids (Albert et al 1998, 2002, Burr et al., 1989, Dallongeville et al 2003, Djousse et al 2001, Dolecek 1992,

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GISSI-Prevenzione Investigators 1999, Hu et al 1999, Pischon et al 2003, WHO 2003). Early on, because of the nature of the fish oils used in studies, these benefits were attributed to EPA and its impact on eicosanoid production (Simopoulos 1991) but recent studies suggest that DHA is the primary mediator of cardiovascular benefits, influencing gene expression of key metabolic regulators, particularly in endothelial cells (Mori et al 1999). The potential role of DPA, as a very minor component of fish oil, has been largely ignored, despite the fact that recent research shows DPA contributes almost 30% of total LC n-3 in our diet (Howe et al 2003, 2005). Until dose-response relationships have been established, the relative efficacy of EPA, DPA and DHA remains uncertain. Moreover, the extent of their interconversion is also uncertain. Hence it is not possible to differentiate between intake requirements for EPA, DPA and DHA at this stage. A lack of dietary n-6 or n-3 polyunsaturated fatty acids is characterised by rough, scaly skin, dermatitis, increased transepidermal water loss, reduced growth and a high triene: tetraene ratio (Goodgame et al 1978, Holman et al 1982, Jeppersen et al 2000, Mascioli et al 1996, O'Neill et al 1977).

They cannot be formed in the body and is therefore essential in the diet. (p.32)

Recommended intake for Children

(2006): page 33:

Boys & Girls aged 4-8, 55mg / day (Dha+EPA+DPA)

Boys aged 9-13: 70 mg / day

Girls aged 9-13: 70 mg/ day

Boys aged 14-18: 125 mg/day.

Girls aged 14-19: 85 mg/day.

Upper limit (p. 34), 3,000 mg/day

New Zealand Product Meeting Standards NutraLife Omega Smart Bites

NutraLife Omega Smart Bites. 811mg Omega 3 triglyceride concentrate, 350mg Docosahexaenoic Acid (DHA) and 73 mg. Eicosapentaenoic Acid (EPA). This is made in New Zealand from 'globally sourced' ingredients.

Fish oil must be protected against oxidation—this protects their potency and they will have no taste or smell.

The Omega 3 juice used in the Raine Study (see below) is not available in New Zealand, and is produced by Smartfish, a Norwegian company, using locally caught fish. They sell some products through pharmacies, medical wholesalers and directly to hospitals. *Recharge*, the omega-3 in a healthy juice, is sold from their website.

<u>Research on deficiencies of Omega 3 in the population</u>[20]

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Citation: Meyer, B. J. (2016). Australians are not meeting the recommended intakes for Omega-3 Long Chain Polyunsaturated Fatty Acids: Results of an analysis from the 2011-2012 National Nutrition and Physical Activity Survey. *Nutrients, 8,* (111), 1-12.

Abstract: Health benefits have been attributed to omega-3 long chain polyunsaturated fatty acids (n-3 LCPUFA). Therefore it is important to know if Australians are currently meeting the recommended intake for n-3 LCPUFA and if they have increased since the last National Nutrition Survey in 1995 (NNS 1995). Dietary intake data was obtained from the recent 2011–2012 National Nutrition and Physical Activity Survey (2011–2012 NNPAS). Linoleic acid (LA) intakes have decreased whilst alpha-linolenic acid (LNA) and n-3 LCPUFA intakes have increased primarily due to n-3 LCPUFA supplements. The median n-3 LCPUFA intakes are less than 50% of the mean n-3 LCPUFA intakes which highlights the highly-skewed n-3 LCPUFA intakes, which shows that there are some people consuming high amounts of n-3 LCPUFA, but the vast majority of the population are consuming much lower amounts. Only 20% of the population meets the recommended n-3 LCPUFA intakes and only 10% of women of childbearing age meet the recommended docosahexaenoic acid (DHA) intake. Fish and seafood is by far the richest source of n-3 LCPUFA including DHA.

In children aged 2-11 years

Harika, R. K., Eilander, A., Alssema, M., Osendarp, S. J., & Zock, P. L. (2013). Intake of fatty acids in general populations worldwide does not meet dietary recommendations to prevent coronary heart disease: a systematic review of data from 40 countries. *Annals of Nutrition and Metabolism*, *63*(3), 229-238.

In New Zealand

New Zealand population in general was about 20% below the recommended intake of PUFA in the worldwide study, above.

Research on the importance of omega-3 in brain development, and deficiencies of omega-3 in children with behavioural problems

1. Callous-unemotional and anti-social traits in ADHD are associated with lower Omega-3 levels.

Citation: Gow, R. V., Vallee-Tourangeau, F., Crawford, M. A., Taylor, E., Ghebremeskel, K., Bueno, A. A., ... & Rubia, K. (2013). Omega-3 fatty acids are inversely related to callous and unemotional traits in adolescent boys with attention deficit hyperactivity disorder. *Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA)*, *88*(6), 411-418.

Abstract: A number of research studies have reported abnormal plasma fatty acid profiles in children with ADHD along with some benefit of *n*−3 to symptoms of ADHD. However, it is currently unclear whether (lower) long chain-polyunsaturated fatty acids (LC-PUFAs) are related to ADHD pathology or to associated behaviours. The aim of this study was to test whether (1) ADHD children have abnormal plasma LC-PUFA levels and (2) ADHD symptoms and associated behaviours are correlated with LC-PUFA levels. Seventy-two male children with (*n*=29) and without a clinical diagnosis of ADHD (*n*=43) were compared in their plasma levels of LC-PUFA. Plasma DHA was higher in the control group prior to statistical correction. Callous–unemotional (CU) traits were found to be significantly negatively related to both eicosapentaenoic acid (EPA), and total Omega-3 in the ADHD group. The findings unveil for the first time that CU and anti-social traits in ADHD are associated with lower Omega-3 levels..

2. Omega-3 in preventing aggression and hostility.

Citation: Hibbeln, J. R., Ferguson, T. A., & Blasbalg, T. L. (2006). Omega-3 fatty acid deficiencies in neurodevelopment, aggression and autonomic dysregulation: opportunities for intervention. *International Review of Psychiatry*, *18*(2), 107-118.

Abstract: Mechanisms by which aggressive and depressive disorders may be exacerbated by nutritional deficiencies in Omega-3 fatty acids are considered. Early developmental deficiencies in docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) may lower serotonin levels at critical periods of neurodevelopment and may result in a cascade of suboptimal development of neurotransmitter systems limiting regulation of the limbic system by the frontal cortex. Residual developmental deficits may be manifest as dysregulation of sympathetic responses to stress including decreased heart rate variability and hypertension, which in turn have been linked to behavioral dysregulation. Little direct data are available to disentangle residual neurodevelopmental effects from reversible adult pathologies. Ensuring optimal intakes of Omega-3 fatty acids during early development and adulthood shows considerable promise in preventing aggression and hostility.

3. Omega 3 during pregnancy and during breastfeeding decreases risk of poor child brain development.

Citation: Innis, S. M. (2008). Dietary Omega 3 fatty acids and the developing brain. *Brain research*, *1237*, 35-43.

Abstract: The ω-3 fatty acids are essential dietary nutrients and one of their important roles is providing the fatty acid with 22 carbons and 6 double bonds known as docosahexaenoic acid (DHA) for nervous tissue growth and function. Inadequate intakes of ω-3 fatty acids decrease DHA and increase ω-6 fatty acids in the brain. Decreased DHA in the developing brain leads to deficits in neurogenesis, neurotransmitter metabolism, and altered learning and visual function in animals. Western diets are low in ω-3 fatty acids, including the 18 carbon ω-3 fatty acid alpha linolenic acid found mainly in plant oils, and DHA, which is found mainly in fish. The DHA status of the newborn and breast-fed infant depends on the maternal intake of DHA and varies widely. Epidemiological studies have linked low maternal DHA to increased risk of poor child neural development. Intervention studies have shown improving maternal DHA nutrition decreases the risk of poor infant and child visual and neural development. Thus, sufficient evidence is available to conclude that maternal fatty acid nutrition is important to DHA transfer to the infant before and after birth, with short and long-term implications for neural function. However, genetic variation in genes encoding fatty acid desaturases also influence essential fatty acid metabolism, and may increase requirements in some individuals. Consideration of ω-3 fatty acid to include brain development, optimizing ω-3 and ω-6 fatty acids in gestation and lactation, and in fatty acid nutrition support for intravenous and formula-fed neonates is important.

4. Lower levels of Omega 3 in children with ADHD; Intervention with Omega 3 shows improvement in ADHD and conduct disorder behaviours.

Citation: Rachel V. Gow, Joseph R. Hibbeln, Omega-3 Fatty Acid and Nutrient Deficits in Adverse Neurodevelopment and Childhood Behaviors, Child and Adolescent Psychiatric Clinics of North America, Volume 23, Issue 3, July 2014, Pages 555-590, ISSN 1056-4993,

http://dx.doi.org/10.1016/j.chc.2014.02.002.
(http://www.sciencedirect.com/science/article/pii/S1056499314000248) Keywords: Omega-3 fatty acids; Eicosapentaenoic acid; Docosahexaenoic acid; Arachidonic acid; Child neurodevelopment; Attention-deficit/hyperactivity disorder; Conduct disorder; Learning disorders

Abstract

•Omega-3 highly unsaturated fatty acids (HUFAs) are critical for both structure and function of the brain.

•The omega-3 HUFA docosahexaenoic acid (DHA) and the omega-6 HUFA arachidonic acid (AA) are especially critical for the development of the central nervous system.

•Omega-3 and Omega-6 fatty acids have distinct roles and require a balance of Omega-3/-6 for optimal physical and mental health. An excessive intake of one type of fatty acid may inhibit the conversion of the other.

•EPA-rich formulas are linked to improvements in mood and symptoms of attention-deficit/hyperactivity disorder (ADHD).

•The American Psychiatric Association Task Force on Complementary and Alternative Medicine recommends that the dietary intake of Omega-3 for patients with poor impulse control, mood disorders, or psychotic disorders should include eicosapentaenoic acid + docosahexaenoic acid at a daily dose of approximately 1 gram.

•Lower concentrations of omega-3 fatty acids have been present in both plasma and red blood cells of children and young adults with ADHD in comparison with healthy controls.

•Supplementation with Omega-3 HUFAs in clinical trials have found some improvement in learning capacity and behavior in youths who are academically underachieving, have ADHD-like symptoms, and/or have severe misconduct.

•The relationship between nutritional deficiencies, in particular of Omega-3 fats, and symptoms of mental ill-health, warrants closer examination by clinicians and mental health practitioners.

5. Chang, C. Y., Ke, D. S., & Chen, J. Y. (2009). Essential fatty acids and human brain. *Acta Neurol Taiwan*, *18*(4), 231-41.

Abstract.The human brain is nearly 60 percent fat. We've learned in recent years that fatty acids are among the most crucial molecules that determine your brain's integrity and ability to perform. Essential fatty acids (EFAs) are required for maintenance of optimal health but they can not synthesized by the body and must be obtained from dietary sources. Clinical observation studies has related imbalance dietary intake of fatty acids to impaired brain performance and diseases. Most of the brain growth is completed by 5-6 years of age. The EFAs, particularly the omega-3 fatty acids, are important for brain development during both the fetal and postnatal period. Dietary decosahexaenoic acid (DHA) is needed for the optimum functional maturation of the retina and visual cortex, with visual acuity and mental development seemingly improved by extra DHA. Beyond their important role in building the brain structure, EFAs, as messengers, are involved in the synthesis and functions of brain neurotransmitters, and in the molecules of the immune system. Neuronal membranes contain phospholipid pools that are the reservoirs for the synthesis of specific lipid messengers on neuronal stimulation or injury. These messengers in turn participate in signaling cascades that

can either promote neuronal injury or neuroprotection. The goal of this review is to give a new understanding of how EFAs determine our brain's integrity and performance, and to recall the neuropsychiatric disorders that may be influenced by them. As we further unlock the mystery of how fatty acids affect the brain and better understand the brain's critical dependence on specific EFAs, correct intake of the appropriate diet or supplements becomes one of the tasks we undertake in pursuit of optimal wellness.

6. Lower levels of Omega 3 in boys with behaviour problems, learning problems and sleep problems.

Citation. Stevens, L. J., Zentall, S. S., Abate, M. L., Kuczek, T., & Burges, J. R. (1996). Omega-3 fatty acids in boys with behavior, learning, and health problems. *Physiology & Behavior*, *59*(4), 915-920.

Abstract. The purpose of the study reported here was to compare behavior, learning, and health problems in boys ages 6 to 12 with lower plasma phospholipid total omega-3 or total omega-6 fatty acid levels with those boys with higher levels of these fatty acids. A greater frequency of symptoms indicative of essential fatty acid deficiency was reported by the parents of subjects with lower plasma omega-3 or omega-6 fatty acid concentrations than those with higher levels. A greater number of behavior problems, assessed by the Conners' Rating Scale, temper tantrums, and sleep problems were reported in subjects with lower total omega-3 fatty acid concentrations. Additionally, more learning and health problems were found in subjects with lower total omega-3 fatty acid concentrations. (Only more colds and more antibiotic use were reported by those subjects with lower total omega-6 fatty acids.) These findings are discussed in relation to recent findings for omega-3 experimentally deprived animals.

7. Lower levels of Omega 3 in children with dyslexia predict reading difficulties

Citation: Richardson, A. J., Calvin, C. M., Clisby, C., Schoenheimer, D. R., Montgomery, P., Hall, J. A., ... & Stein, J. F. (2000). Fatty acid deficiency signs predict the severity of reading and related difficulties in dyslexic children. *Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA)*, *63*(1), 69-74.

Abstract. It has been proposed that developmental dyslexia may be associated with relative deficiencies in certain highly unsaturated fatty acids (HUFA). In children with attention-deficit/hyperactivity disorder, minor physical signs of fatty acid deficiency have been shown to correlate with blood biochemical measures of HUFA deficiency. These clinical signs of fatty acid deficiency were therefore examined in 97 dyslexic children in relation to reading and related skills, and possible sex differences were explored.

Children with high fatty acid deficiency ratings showed poorer reading ($P<0.02$) and lower general ability ($P<0.04$) than children with few such clinical signs. Within males ($n=72$) these relationships were stronger, and fatty acid deficiency signs were also associated with poorer spelling and auditory working memory ($P<0.05$, $P<0.005$ respectively). Within females ($n=25$) no associations were significant. These results support the hypothesis that fatty acid deficiency may contribute to the severity of dyslexic problems, although sex differences merit further investigation.

8. Lower levels of Omega 3 in children with ADHD

Citation. Burgess, J. R., Stevens, L., Zhang, W., & Peck, L. (2000). Long-chain polyunsaturated fatty acids in children with attention-deficit hyperactivity disorder. *The American journal of clinical nutrition*, *71*(1), 327S-330S.

Abstract. Attention-deficit hyperactivity disorder (ADHD) is the diagnosis used to describe children who are inattentive, impulsive, and hyperactive. ADHD is a widespread condition that is of public health concern. In most children with ADHD the cause is unknown, but is thought to be biological and multifactorial. Several previous studies indicated that some physical symptoms reported in ADHD are similar to symptoms observed in essential fatty acid (EFA) deficiency in animals and humans deprived of EFAs. We reported previously that a subgroup of ADHD subjects reporting many symptoms indicative of EFA deficiency (L-ADHD) had significantly lower proportions of plasma arachidonic acid and docosahexaenoic acid than did ADHD subjects with few such symptoms or control subjects. In another study using contrast analysis of the plasma polar lipid data, subjects with lower compositions of total n−3 fatty acids had significantly more behavioral problems, temper tantrums, and learning, health, and sleep problems than did those with high proportions of n−3 fatty acids. The reasons for the lower proportions of long-chain polyunsaturated fatty acids (LCPUFAs) in these children are not clear; however, factors involving fatty acid intake, conversion of EFAs to LCPUFA products, and enhanced metabolism are discussed. The relation between LCPUFA status and the behavior problems that the children exhibited is also unclear. We are currently testing this relation in a double-blind, placebo-controlled intervention in a population of children with clinically diagnosed ADHD who exhibit symptoms of EFA deficiency.

Research indicating associations between diet via epigenetic influences, myelination, behaviour problems and omega-3

1. Exposure to stress can induce long lasting changes in DNA methylation and these may relate to PTSD

Citation: Klengel, T., Pape, J., Binder, E. B., & Mehta, D. (2014). The role of DNA methylation in stress-related psychiatric disorders. *Neuropharmacology*, *80*, 115-132.

Abstract: Epigenetic modifications in response to traumatic experience and stress are emerging as important factors in the long-term biological trajectories leading to stress-related psychiatric disorders, reflecting both environmental influences as well as individual genetic predisposition. In particular, recent evidence on DNA methylation changes within distinct genes and pathways but also on a genome-wide level provides new insights into the pathophysiology of stress related psychiatric disorders. This review summarizes current findings and concepts on DNA methylation changes in stress-related disorders with a focus on major depressive disorder and posttraumatic stress disorder (PTSD). We highlight studies of DNA methylation in animals and humans pertinent to these disorders, both focusing on candidate loci as well as genome-wide studies. We describe molecular mechanisms of how exposure to stress can induce long lasting changes in DNA methylation and how these may relate to the pathophysiology of depression and PTSD. We discuss data suggesting that DNA methylation, even in peripheral tissues, appears to be an informative reflection of environmental exposures on the genome and may have potential as a biomarker for the early prevention of stress-related disorders.

2. Link between imbalance of Omega 3 and Omega 6 and neurodevelopmental disorders.

Citation: Schuchardt, J. P., Huss, M., Stauss-Grabo, M., & Hahn, A. (2010). Significance of long-chain polyunsaturated fatty acids (PUFAs) for the development and behaviour of children. *European Journal of Pediatrics*, *169*(2), 149-164.

Abstract: ω-6 and ω-3 polyunsaturated fatty acids (PUFAs) play a central role in the normal development and functioning of the brain and central nervous system. Long-chain PUFAs (LC-PUFAs) such as eicosapentaenoic acid (EPA, C20:5ω-3), docosahexaenoic acid (DHA, C22:6ω-3) and arachidonic acid (AA, C20:4ω-6), in particular, are involved in numerous neuronal processes, ranging from effects on membrane fluidity to gene expression regulation. Deficiencies and imbalances of these nutrients, not only during the developmental phase but throughout the whole life span, have significant effects on brain function. Numerous observational studies have shown a link between childhood developmental disorders and ω-6:ω-3 fatty acid imbalances. For instance, neurocognitive disorders such as attention-deficit hyperactivity disorder (ADHD), dyslexia, dyspraxia and autism spectrum disorders are often associated with a relative lack of ω-3 fatty acids. In addition to a high ω-6 fatty acid intake and, in many cases, an insufficient supply of ω-3 fatty acids among the population, evidence is increasing to suggest that PUFA metabolism can be impaired in individuals with ADHD. In this context, PUFA imbalances are being discussed as potential risk factors for neurodevelopmental disorders. Another focus is whether the nutritive PUFA requirements—especially long-chain ω-3 fatty acid requirements—are higher among some individuals. Meanwhile, several controlled studies investigated the clinical benefits of LC-PUFA supplementation in affected children and adolescents, with occasionally conflicting results.

3. Neuroimaging shows impaired brain networks that are associated with demyelination, regulation of mood and affect, etc. in children with ADHD, and the role of Omega 3.

Citation: Gow, R. V., & Hibbeln, J. R. (2014). Omega-3 and treatment implications in Attention Deficit Hyperactivity Disorder (ADHD) and associated behavioral symptoms. *Lipid Technology*, *26*(1), 7-10.

Abstract: Attention Deficit Hyperactivity Disorder (ADHD) is a chronic neurodevelopmental disorder with core symptoms of inattention, hyperactivity and impulsivity. Marked impairments are also well-documented in self-regulatory and executive function skills associated with temporal organization, working memory, goal-directed behaviors and maintaining motivation, focus and effort. Another recognized feature of ADHD is the concept of emotional dysregulation which is the inability to regulate emotional processes and can often manifest as instability in temperament, and explosive temper. Although there is a high degree of heritability for symptoms of ADHD, somewhere in the region of 65–75%, most of the genetic effect is considered accountable by gene/environmental interactions. One plausible environmental postulation is the hypothesis of inadequate neuronal levels of omega-3 highly unsaturated fatty acids (HUFAs) leading to abnormalities in dopamine-related neurotransmission in the frontal cortex and reward-related pathways in the ventral striatum regions. Neuroimaging studies have confirmed that these brain networks are impaired in ADHD compared to control counterparts during a range of tasks measuring motivation and reward management processes. Omega-3 highly unsaturated fatty acids have critical roles throughout the central nervous system featuring in complex structural and functional processes related, but not restricted to myelination, cell-signaling, gene expression and in the regulation of mood and affect. This article will present and discuss evidence from several clinical studies and raise questions regarding future research directions.

4. Stress/environment interactions with nutrient deficiency early in life mediates brain dysfunction leading to behaviour problems.

Citation: Liu, J.; Zhao, S.R.; Reyes, T. (2015). Neurological and epigenetic implications of nutritional deficiencies on psychopathology: Conceptualization and review of evidence. *Int. J. Mol. Sci.*, *16*, 18129-18148.

Abstract: In recent years, a role for epigenetic modifications in the pathophysiology of disease has received significant attention. Many studies are now beginning to explore the gene–environment interactions, which may mediate early-life exposure to risk factors, such as nutritional deficiencies and later development of behavioral problems in children and adults. In this paper, we review the current literature on the role of epigenetics in the development of psychopathology, with a specific focus on the potential for epigenetic modifications to link nutrition and brain development. We propose a conceptual framework whereby epigenetic modifications (e.g., DNA methylation) mediate the link between micro- and macro-nutrient deficiency early in life and brain dysfunction (e.g., structural aberration, neurotransmitter perturbation), which has been linked to development of behavior problems later on in life.

5. Diet may contribute to behavioural plasticity.

Citation: Patrick O. McGowan, Michael J. Meaney, Moshe Szyf. (2008). Diet and the epigenetic (re)programming of phenotypic differences in behavior, *Brain Research*, *1237*, 12-24, ISSN 0006-8993, http://dx.doi.org/10.1016/j.brainres.2008.07.074. (http://www.sciencedirect.com/science/article/pii/S0006899308018167) Keywords: DNA methylation; Demethylation; Maternal care; Nutrition; Methionine; TSA; HDAC inhibitor; Mental health; Psychopathology; Human brain; Rodent; Gene environment interaction; Stress; Glucocorticoid receptor; Histone acetylation; NGFI-A

Abstract: Phenotypic diversity is shaped by both genetic and epigenetic mechanisms that program tissue specific patterns of gene expression. Cells, including neurons, undergo massive epigenetic reprogramming during development through modifications to chromatin structure, and by covalent modifications of the DNA through methylation. There is evidence that these changes are sensitive to environmental influences such as maternal behavior and diet, leading to sustained differences in phenotype. For example, natural variations in maternal behavior in the rat that influence stress reactivity in offspring induce long-term changes in gene expression, including in the glucocorticoid receptor, that are associated with altered histone acetylation, DNA methylation, and NGFI-A transcription factor binding. These effects can be reversed by early postnatal cross-fostering, and by pharmacological manipulations in adulthood, including Trichostatin A (TSA) and l-methionine administration, that influence the epigenetic status of critical loci in the brain. Because levels of methionine are influenced by diet, these effects suggest that diet could contribute significantly to this behavioral plasticity. Recent data suggest that similar mechanisms could influence human behavior and mental health. Epidemiological data suggest indeed that dietary changes in methyl contents could affect DNA methylation and gene expression programming. Nutritional restriction during gestation could affect epigenetic programming in the brain. These findings provide evidence for a stable yet dynamic epigenome capable of regulating phenotypic plasticity through epigenetic programming.

6. Omega 3 in children aged 10-12 is associated with better executive function and decision-making.

Sheppard, K., & Cheatham, C. L. (2017). The Omega-6 to Omega-3 Fatty Acid Ratio Predicts Brain Activity During Planning Tasks in Middle Childhood. *The FASEB Journal*, *31*(1 Supplement), 636-8.

Abstract. The dietary omega-6 (n-6) to omega-3 (n-3) fatty acid (FA) ratio (n-6/n-3 ratio) has been shown to predict planning abilities in children 7 to 12 years old. We previously demonstrated that a balanced n-6/n-3 ratio and n-3 intake (e.g., low n-3 intake with a low n-6/n-3 ratio) predicted better performance on difficult planning problems in 7- to 9-year-olds, and unbalanced intake (e.g., high n-3 intake with a low n-6/n-3 ratio) predicted better performance in 10- to 12-year-olds. These results imply important developmental considerations for the role of n-6 and n-3 FAs in cognitive function. We further explored the role of n-6 and n-3 FAs in brain function by collecting brain imaging data from the prefrontal cortex (PFC) using near-infrared spectroscopy (NIRS) with 57 children (29 children 7 to 9 years old and 28 children 10 to 12 years old) who completed the Stockings of Cambridge (SOC) planning task from the Cambridge Neuropsychological Test Automated Battery (CANTAB). We computed the oxygenated hemoglobin (oxyHb) levels in the left PFC, central PFC, and right PFC (Figure 1) related to children solving simple planning problems (3-move problems), difficult planning problems (5-move problems), and the change in brain activity moving from 3-move to 5-move problems. The difference in brain activity from 3-move to 5-move problems represents both the increased number of moves required and the need to make the counterintuitive moves required of 5-move problems.

Correlations between brain activity and SOC performance indicated that greater activity when solving 3-move problems and reduced activity when moving from 3-move to 5-move problems was related to improved performance (making fewer errors and solving more problems in the minimum number of moves). Increased use of the PFC was important for solving simpler planning problems, and efficiency was important for the ability to make counterintuitive moves and solve more difficult planning problems. Multivariate regressions were run using the n-6/n-3 ratio, n-3 intake, and their interaction to predict brain activity in the PFC related to solving planning problems above and beyond maternal education and physical activity. The interaction between the n-6/n-3 ratio and n-3 intake predicted brain activity in the central PFC when moving from the 3-move to 5-move planning problems differently in 7- to 9-year-olds ($t(21) = -2.73$, $p < 0.05$, $R^2 = 0.14$) and 10- to 12-year-olds ($t(19) = 2.53$, $p < 0.05$, $R^2 = 0.19$). In 7- to 9-year-olds (Figure 2), balanced n-6/n-3 ratio and n-3 intake predicted reduced central PFC activity moving from 3-move to 5-move problems, which was associated with improved planning performance. In 10- to 12-year-olds (Figure 3), unbalanced n-6/n-3 ratio and n-3 intake predicted reduced central PFC activity. These results further support considering the overall balance of n-6 and n-3 FAs, and highlight the need to consider developmental changes that affect the brain's nutritional needs. The 10- to 12-year-olds were likely entering puberty, a time of considerable brain growth that may be best supported by increased n-3 intake and lower n-6/n-3 ratios, whereas younger children may require greater balance of n-6 and n-3 FAs to support flexible use of cortical resources as they become more adept at increasingly challenging cognitive tasks.

Treating Behaviour Problems with Omega 3

Meta-analyses of treatment studies of omega-3

1. Omega 3 supplementation reduced aggressive and violent behaviour.

Benton D (2007) The impact of diet on anti-social behaviour. *Neurosci Biobehav Rev* 31:752–774.

Abstract:

The role of diet in anti-social behaviour was considered, paying particular attention to double-blind placebo-controlled trials. Meta-analysis of five well-designed studies found that elimination diets reduced hyperactivity-related symptoms, producing a summary standardized mean difference (SSMD) of 0.80 (95% CI 0.41–1.19). The picture was of children potentially responding to a wide range of food items although the pattern was individual to the child. Supplementation with poly-unsaturated fatty acids decreased violence (SSMD −0.61, 95% CI −0.83 to −0.39) although there was no evidence of an influence on hyperactivity. Three well-designed studies have reported that vitamin/mineral supplementation reduced anti-social behaviour. There are also findings of an association between a tendency to develop low blood glucose and aggression. Many responses to diet were idiosyncratic and involved a wide range of foods interacting with individual differences in physiology. Reactions were not observed in all members of groups chosen because they share a common behavioural designation or diagnosis.

2. Gajos, J. M., & Beaver, K. M. (2016). The effect of omega-3 fatty acids on aggression: A meta-analysis. *Neuroscience & Biobehavioral Reviews*, *69*, 147-158.

Evidence suggests that omega-3 fatty acids are important for a variety of mental health outcomes and have been shown to improve both mood and behaviors. However, there is little consensus on whether omega-3 fatty acids are beneficial for reducing aggressive behaviors. The current study assesses the relationship between omega-3 fatty acids and aggression. A total of 73 effect sizes were calculated among 40 studies involving 7173 participants from both intervention and observational research designs. Effect sizes were separately meta-analyzed for two-group comparison studies ($SMD = 0.20$), pre-post contrast studies ($ES_{sg} = 0.62$), and associational studies ($r = -0.06$), in the fixed-effect model. Results from the random-effects model also suggest a range of effects of omega-3 fatty acids on reducing aggression ($SMD = 0.24$; $ES_{sg} = 0.82$; $r = -0.09$). Patterns in the relationship between omega–3s and aggression were additionally observed. Moderator analyses indicated that the effect of omega–3s on aggression is conditioned by how aggressive behaviors are measured, such as through self-report or parent/teacher surveys.

3. Omega-3 fatty acid supplementation demonstrated a small but significant effect in improving ADHD symptoms in children.

Citation: Michael H. Bloch, Ahmad Qawasmi, Omega-3 Fatty Acid Supplementation for the Treatment of Children With Attention-Deficit/Hyperactivity Disorder Symptomatology: Systematic Review and Meta-Analysis, Journal of the American Academy of Child & Adolescent Psychiatry, Volume 50, Issue 10, October 2011, Pages 991-1000, ISSN 0890-8567, http://dx.doi.org/10.1016/j.jaac.2011.06.008.(http://www.sciencedirect.com/science/article/pii/S0890856711004849)

Abstract. Objective Several studies have demonstrated differences in omega-3 fatty acid composition in plasma and in erythrocyte membranes in patients with attention-deficit/hyperactivity disorder (ADHD) compared with unaffected controls. Omega-3 fatty acids have anti-inflammatory properties and can alter central nervous system cell membrane fluidity and phospholipid composition. Cell membrane fluidity can alter serotonin and dopamine neurotransmission. The goal of this meta-analysis was to examine the efficacy of omega-3 fatty acid supplementation in children with ADHD.

Method: PubMed was searched for randomized placebo-controlled trials examining omega-3 fatty acid supplementation in children with ADHD symptomatology. The primary outcome measurement was standardized mean difference in rating scales of ADHD severity. Secondary analyses were conducted to determine the effects of dosing of different omega-3 fatty acids in supplements.

Results: Ten trials involving 699 children were included in this meta-analysis. Omega-3 fatty acid supplementation demonstrated a small but significant effect in improving ADHD symptoms. Eicosapentaenoic acid dose within supplements was significantly correlated with supplement efficacy. No evidence of publication bias or heterogeneity between trials was found.

Conclusion: Omega-3 fatty acid supplementation, particularly with higher doses of eicosapentaenoic acid, was modestly effective in the treatment of ADHD. The relative efficacy of Omega-3 fatty acid supplementation was modest compared with currently available pharmacotherapies for ADHD such as psychostimulants, atomoxetine, or α2 agonists. However, given its relatively benign side-effect profile and evidence of modest efficacy, it may be reasonable to use Omega-3 fatty supplementation to augment traditional pharmacologic interventions or for families who decline other psychopharmacologic options. Key Words: attention-deficit disorder with hyperactivity; polyunsaturated fatty acids; omega-3 fatty acids; eicosapentaenoic acid; meta-analysis.

4. Ortega, R. M., Rodríguez-Rodríguez, E., & López-Sobaler, A. M. (2012). Effects of omega 3 fatty acids supplementation in behavior and non-neurodegenerative neuropsychiatric disorders. *British Journal of Nutrition*, *107*(S2), S261-S270.

5. Omega-3 supplementation during either pregnancy or infancy improves child neurodevelopment

Citation. Shulkin, M. L., Pimpin, L., Bellinger, D., Kranz, S., Duggan, C., Fawzi, W., & Mozaffarian, D. (2016). Effects of omega-3 supplementation during pregnancy and youth on neurodevelopment and cognition in childhood: a systematic review and meta-analysis. *The FASEB Journal [Official Journal of the Federation of American Societies for Experimental Biology]*, *30*(1 Supplement), 295-5.

Abstract. Background. Long-chain omega-3 fatty acids are thought to be crucial for optimal neurodevelopment in early life.

Objectives. To investigate the effect of omega-3 supplementation during pregnancy and infancy on child cognitive and developmental outcomes.

Methods. We searched PubMed, Cochrane Library, EMBASE, and PsychInfo through May 2015 without language or publication year restrictions for randomized controlled trials (RCTs) of omega-3 supplementation (>3 months) i.e. docosahexanoic acid (DHA) and eicosapentaenoic acid (EPA), and quantitative measure of neurodevelopment or cognition.

Full-text inclusion decisions and data extractions were performed independently and in duplicate. Our primary outcome was the standardized mean difference in Bayley Scales of Infant Development (BSID) score between intervention groups in RCTs. Other outcomes included the Weschler Intelligence Scale for Children, Weschler Preschool and Primary Scale of Intelligence, Kaufman Brief Intelligence Test, Kaufman Assessment Battery for Children, Peabody Picture Vocabulary Test, and other standardized measures.

Results. Among 571 abstracts, we identified 15 trials with 20 intervention arms involving 2,525 children. Trials used DHA + EPA (N=6 arms), DHA only (N=2), DHA + arachidonic acid (AA) (N=10), or DHA + EPA + AA (N=2); either prenatally (mean 20 weeks gestation; N=4 arms) or within the first few days of birth (N=16). Mean supplementation duration was 7.3 months; and age at outcome assessment, 16 months. In pooled analyses, both maternal and infant supplementation similarly improved neurodevelopment: standardized mean difference (SMD) in BSID= 0.21 (95% CI: 0.01, 0.41) and 0.24 (0.00, 0.48) respectively (Figure 1). Among BSID subscales, DHA and/or EPA raised the psychomotor developmental index (N=8 arms; SMD 0.40; 95% CI: 0.10, 0.70), while DHA + AA raised the mental developmental index (N=15 arms; SMD 0.17; 95% CI: 0.00, 0.35). Pooled findings for other outcomes will be presented.

Conclusion. Omega-3 supplementation during either pregnancy or infancy improves child neurodevelopment. These findings indicate the importance of sufficient polyunsaturated fatty acid intake by pregnant women and young children.

6. Significant reduction in emotional lability and oppositional behaviour with Omega 3 supplementation in high quality studies of children with ADHD.

Citation. Cooper, R. E., Tye, C., Kuntsi, J., Vassos, E., & Asherson, P. (2016). The effect of omega-3 polyunsaturated fatty acid supplementation on emotional dysregulation, oppositional behaviour and conduct problems in ADHD: A systematic review and meta-analysis. *Journal of affective disorders*, *190*, 474-482.

Abstract.*Background.* A number of randomised controlled trials report a beneficial effect of omega-3 polyunsaturated fatty acid (*n*-3 PUFA) supplementation on emotional lability (EL) and related domains (e.g. oppositional behaviour, conduct problems). Given that *n*-3 PUFA supplementation shows a significant effect on reducing symptoms of attention-deficit/hyperactivity disorder (ADHD) and that EL and related behaviours commonly co-occurs with ADHD, it is important that there is a more conclusive picture as to the effect of *n*-3 PUFA on these co-occurring clinical domains.

Methods. Databases (Ovid Medline, Embase, Psychinfo) were searched for trials assessing the effects of *n*-3 PUFA on EL, oppositional behaviour, aggression and conduct problems. We included trials in children who had ADHD or a related neurodevelopmental disorder.

Results. Of the 1775 identified studies, 10 were included in the meta-analysis. In the primary analyses *n*-3 PUFA supplementation did not show improvements in measures of EL, oppositional behaviour, conduct problems or aggression. However subgroup analyses of higher quality studies and those meeting strict inclusion criteria found a significant reduction in EL and oppositional behaviour.

Limitations. A number of treatment effects may have failed to reach statistical significance due to small sample sizes and within and between study heterogeneity in terms of design and study participants.

Conclusions. These results exclude the possibility of moderate to large effects. They provide suggestive evidence of small effects of *n*-3 PUFA on reducing EL and oppositional behaviour in subgroups of children with ADHD.

Comment: Only 10 studies included in the final analysis.

7. Young, A. S., Arnold, L. E., Wolfson, H. L., & Fristad, M. A. (2017). Psychoeducational psychotherapy and omega-3 supplementation improve co-occurring behavioral problems in youth with depression: results from a pilot RCT. *Journal of abnormal child psychology*, *45*(5), 1025-1037.

Abstract. This pilot randomized controlled trial (RCT) investigated benefits of omega-3 fatty acid supplementation and Individual-Family Psychoeducational Psychotherapy (PEP; a family-focused, cognitive-behavioral therapy) for behavior problems among youth with depression. Participants aged 7–14 with DSM-IV-TR depressive disorders ($N = 72$; 56.9 % male) were randomized to 1 of 4 treatment conditions: PEP + omega-3, PEP monotherapy (with pill placebo), omega-3 monotherapy, or placebo (without active intervention). At screen, baseline, and 2, 4, 6, 9, and 12 weeks post-baseline, parents completed the SNAP-IV, which assesses attention-deficit/hyperactivity disorder symptoms, oppositional defiant disorder symptoms, and overall behavior problems. At screen, baseline (randomization), 6 and 12 weeks, parents completed the Eyberg Child Behavior Inventory (ECBI), which includes Intensity and Problem scales for child behavior problems. Youth who had a completed SNAP-IV or ECBI for at least two assessments during treatment ($n = 48$ and 38, respectively) were included in analyses of the respective outcome. ClinicalTrials.gov.:NCT01341925. Linear mixed effects models indicated a significant effect of combined PEP + omega-3 on SNAP-IV Total ($p = 0.022$, $d = 0.80$) and Hyperactivity/Impulsivity trajectories ($p = 0.008$, $d = 0.80$), such that youth in the combined group saw greater behavioral improvement than those receiving only placebo. Similarly, youth in combined treatment had more favorable ECBI Intensity trajectories than youth who received no active treatment ($p = 0.012$, $d = 1.07$). Results from this pilot RCT suggest that combined PEP + omega-3 is a promising treatment for co-occurring behavior symptoms in youth with depression.

8. Hoare, S., Lithander, F., van der Mei, I., Ponsonby, A. L., & Lucas, R. (2016). Higher intake of omega-3 polyunsaturated fatty acids is associated with a decreased risk of a first clinical diagnosis of central nervous system demyelination: Results from the Ausimmune Study. *Multiple Sclerosis Journal*, *22*(7), 884-892.

9. Demyelination is associated with neuroinflammation, which can be associated with oxidative stress which may be caused by PTSD

Citation: Ljubisavljevic, S. (2016). Oxidative stress and neurobiology of demyelination. *Molecular neurobiology*, *53*(1), 744-758. http://link.springer.com/article/10.1007/s12035-014-9041-x

Abstract: Despite a large amount of research which aims at defining the pathophysiology of human demyelination (i.e., multiple sclerosis), etiological bases of disease have been unknown so far. The point of intersection of all assumed etiological factors, which are mainly based upon immunological cascades, is neuroinflammation. The precise definition of the place and role of all pathogenetic factors in the occurrence and development of the disease is

of crucial importance for understanding the clinical nature and for finding more effective therapeutic options. There are few studies whose results give more precise data about the role and the importance of other factors in neuroinflammation, besides immunological ones, with regard to clinical and paraclinical correlates of the disease. The review integrates results found in previously performed studies which have evaluated oxidative stress participation in early and late neuroinflammation. The largest number of studies indicates that the use of antioxidants affects the change of neuroinflammation course under experimental conditions, which is reflected in the reduction of the severity and the total reversibility in clinical presentation of the disease, the faster achieving of remission, and the delayed and slow course of neuroinflammation. Therapies based on the knowledge of redox biology targeting free radical generation hold great promise in modulation of the neuroinflammation and its clinical presentations.

10. Citation: Schiavone, S., Colaianna, M., & Curtis, L. (2015). Impact of early life stress on the pathogenesis of mental disorders: relation to brain oxidative stress. *Current pharmaceutical design*, *21*(11), 1404-1412.

Abstract. Stress is an inevitable part of human life and it is experienced even before birth. Stress to some extent could be considered normal and even necessary for the survival and the regular psychological development during childhood or adolescence. However, exposure to prolonged stress could become harmful and strongly impact mental health increasing the risk of developing psychiatric disorders.

Recent studies have attempted to clarify how the human central nervous system (CNS) reacts to early life stress, focusing mainly on neurobiological modifications. Oxidative stress, defined as a disequilibrium between the oxidant generation and the antioxidant response, has been recently described as a candidate for most of the observed modifications.

In this review, we will discuss how prolonged stressful events during childhood or adolescence (such as early maternal separation, parental divorce, physical violence, sexual or psychological abuses, or exposure to war events) can lead to increased oxidative stress in the CNS and enhance the risk to develop psychiatric diseases such as anxiety, depression, drug abuse or psychosis. Defining the sources of oxidative stress following exposure to early life stress might open new beneficial insights in therapeutic approaches to these mental disorders.

11. Barragán, E., Breuer, D., & Döpfner, M. (2017). Efficacy and safety of omega-3/6 fatty acids, methylphenidate, and a combined treatment in children with ADHD. *Journal of Attention Disorders*, *21*(5), 433-441.

Abstract: Objective: To compare efficacy of Omega-3/6 fatty acids (Equazen eye q™) with methylphenidate (MPH) and combined MPH + Omega-3/6 in children with ADHD.

Method: Participants (*N* = 90) were randomized to Omega-3/6, long-acting MPH, or combination for 12 months. ADHD symptoms were assessed using the ADHD Rating Scale and Clinical Global Impressions–Severity (CGI-S) scale.

Results: ADHD symptoms decreased in all treatment arms. Although significant differences favoring Omega + MPH over Omega-3/6 alone were found for ADHD Total and Hyperactivity-Impulsivity subscales, results on the Inattention subscale were similar. CGI-S scores decreased slowly and consistently with Omega-3/6, compared with a rapid decrease

and subsequent slight increase in the MPH-containing arms. Adverse events were numerically less frequent with Omega-3/6 or MPH + Omega-3/6 than MPH alone.

Conclusion: The tested combination of Omega-3/6 fatty acids had similar effects to MPH, whereas the MPH + Omega combination appeared to have some tolerability benefits over MPH.

12. Johnson, M., Fransson, G., Östlund, S., Areskoug, B., & Gillberg, C. (2017). Omega 3/6 fatty acids for reading in children: a randomized, double-blind, placebo-controlled trial in 9-year-old mainstream schoolchildren in Sweden. *Journal of Child Psychology and Psychiatry*, *58*(1), 83-93.

Objectives: Previous research has shown positive effects of Omega 3/6 fatty acids in children with inattention and reading difficulties. We aimed to investigate if Omega 3/6 improved reading ability in mainstream schoolchildren.

Methods. We performed a 3-month parallel, randomized, double-blind, placebo-controlled trial followed by 3-month active treatment for all subjects. Mainstream schoolchildren aged 9–10 years were randomized 1:1 to receive three Omega 3/6 capsules twice daily or identical placebo. Assessments were made at baseline, 3 months, and 6 months. The primary outcome measure was the Logos test battery for evaluating reading abilities. The trial is registered with ClinicalTrials.gov, number NCT02557477.

Results. The study enrolled 154 children (active $n = 78$; placebo $n = 76$), of whom 122 completed the first 3 months (active $n = 64$; placebo $n = 58$) and 105 completed the whole study (active/active $n = 55$; placebo/active $n = 50$). Outcomes were assessed by per protocol (PP) and intention-to-treat (ITT) analyses. Active treatment was superior to placebo at 3 months for improvement in phonologic decoding time (PP active/placebo difference −0.16; 95% CI −0.03, −0.29; effect size (ES) .44; $p = .005$; and ITT ES .37; $p = .036$), in visual analysis time (PP active/placebo difference −0.19; 95% CI −0.05, −0.33; ES .49; $p = .013$; and ITT ES .40; $p = .01$), and for boys in phonologic decoding time (PP −0.22; 95% CI −0.03, −0.41; ES .62; $p = .004$). Children with ADHD-RS scores above the median showed treatment benefits in visual analysis time (PP ES .8, $p = .009$), reading speed per word (PP ES .61, $p = .008$), and phonologic decoding time per word (PP ES .85, $p = .006$). Adverse events were rare and mild, mainly stomach pain/diarrhea (active $n = 9$, placebo $n = 2$).

Conclusions. Compared with placebo, 3 months of Omega 3/6 treatment improved reading ability – specifically the clinically relevant 'phonologic decoding time' and 'visual analysis time' – in mainstream schoolchildren. In particular, children with attention problems showed treatment benefits.

13. Robertson, R. C., Oriach, C. S., Murphy, K., Moloney, G. M., Cryan, J. F., Dinan, T. G., ... & Stanton, C. (2017). Omega-3 polyunsaturated fatty acids critically regulate behaviour and gut microbiota development in adolescence and adulthood. *Brain, behavior, and immunity*, *59*, 21-37.

A few individual research studies on effects of omega-3 on relevant behaviours

1. A RCT showed Omega 3 supplementation for children aged 8-16 reduced behaviour problems and maintained at 6 months follow-up.

Citation: Raine, A., Portnoy, J., Liu, J., Mahoomed, T., & Hibbeln, J. R. (2015). Reduction in behavior problems with omega-3 supplementation in children aged 8–16 years: a randomized, double-blind, placebo-controlled, stratified, parallel-group trial. *Journal of Child Psychology and Psychiatry*, *56*(5), 509-520.

Abstract.Background. While limited evidence suggests that Omega-3 supplementation may reduce antisocial behavior in children, studies have not reported on posttreatment follow-up and most treatment periods have been of short duration. This study tests the hypothesis that Omega-3 supplementation over 6 months will reduce behavior problems in children both at the end of treatment and at 6 months post treatment.

Methods. In this randomized, double-blind, placebo-controlled, stratified, parallel-group trial, a community sample of 8–16 year old children were randomized into a treatment group (N = 100) and a placebo-control group (N = 100). The supplementation consisted of a fruit drink containing 1 g/day of omega-3 or a placebo consisting of the same fruit drink without omega-3. Participants, caregivers, and research assistants were blinded to group assignment. The primary outcome measures of externalizing and internalizing behavior problems were reported by both caregivers and their children in a laboratory setting at 0 months (baseline), 6 months (end of treatment) and 12 months (6 months post treatment), together with the secondary outcome measures of parental antisocial behavior. Data were analyzed on an intention-to-treat basis including all participants. Trial registration: ClinicalTrials.gov: http://clinicaltrials.gov/ct2/show/NCT02016079?term=mauritius&rank=2

Results. Significant group × time interactions were observed with the treatment group showing long-term improvements in child behavior problems. The average posttreatment effect size was d = −.59. Effects were documented for parent reports, but with the exception of *proactive and reactive aggression*, child-report data were nonsignificant. *Parents whose children took omega-3 showed significant posttreatment reductions in their own antisocial and aggressive behavior*. This improvement in caregiver behavior partly mediated the improvements observed in child behavior.

Conclusions. Findings provide initial evidence that Omega-3 supplementation can produce sustained reductions in externalizing and internalizing behavior problems. Results are the first to report improvements in caregiver behavior, and to establish this improvement as a part-mechanism for the efficacy of Omega-3.

2. Richardson, A. (2015). Omega-3 and sleep: New insights from the DHA Oxford Learning and Behaviour (DOLAB) study. *Lipid Technology*, *27*(5), 103-106.

Abstract. Does dietary intake of omega-3 DHA influence children's sleep? Sleep problems affecting 40% of UK schoolchildren aged 7–9 years were reported in a recent University of Oxford study and lower blood concentrations of omega-3 DHA predicted more serious sleep problems in these otherwise healthy, normal children. In a randomised controlled trial, dietary supplementation with omega-3 DHA (docosahexaenoic acid) for 16 weeks improved parent-rated sleep in children with such problems. Furthermore, objectively measured sleep duration was increased by almost one hour by DHA vs placebo.

3. Paul Montgomery - Omega-3 DHA and Children's Sleep - New Findings from the DOLAB

https://youtu.be/mQSF2L3nS_Q

A You Tube Presentation: “Paul Montgomery - The DOLAB Trial: Effect of DHA on Children's Learning and Behaviour “—improve the reading of children in the lowest 20% to start with.

https://youtu.be/j4mKI-r6s2g

4. Improvement in ADHD symptoms, hyperactivity in children with ADHD.

Citation: I. Manor, A. Magen, D. Keidar, S. Rosen, H. Tasker, T. Cohen, Y. Richter, D. Zaaroor-Regev, Y. Manor, A. Weizman, The effect of phosphatidylserine containing Omega3 fatty-acids on attention-deficit hyperactivity disorder symptoms in children: A double-blind placebo-controlled trial, followed by an open-label extension, European Psychiatry, Volume 27, Issue 5, July 2012, Pages 335-342, ISSN 0924-9338, http://dx.doi.org/10.1016/j.eurpsy.2011.05.004.(http://www.sciencedirect.com/science/article/pii/S0924933811000952)

Abstract: Objective To study the efficacy and safety of phosphatidylserine (PS) containing Omega3 long-chain polyunsaturated fatty acids attached to its backbone (PS-Omega3) in reducing attention-deficit/ hyperactivity disorder (ADHD) symptoms in children.

Method A 15-week, double-blind, placebo-controlled phase followed by an open-label extension of additional 15 weeks. Two hundred ADHD children were randomized to receive either PS-Omega3 or placebo, out of them, 150 children continued into the extension. Efficacy was assessed using Conners’ parent and teacher rating scales (CRS-P,T), Strengths and Difficulties Questionnaire (SDQ), and Child Health Questionnaire (CHQ). Safety evaluation included adverse events monitoring.

Results The key finding of the double-blind phase was the significant reduction in the Global:Restless/impulsive subscale of CRS-P and the significant improvement in Parent impact-emotional (PE) subscale of the CHQ, both in the PS-Omega3 group. Exploratory subgroup analysis of children with a more pronounced hyperactive/impulsive behavior, as well as mood and behavior-dysregulation, revealed a significant reduction in the ADHD-Index and hyperactive components. Data from the open-label extension indicated sustained efficacy for children who continued to receive PS-Omega3. Children that switched to PS-Omega3 treatment from placebo showed a significant reduction in subscales scores of both CRS-P and the CRS-T, as compare to baseline scores. The treatment was well tolerated. Conclusions The results of this 30-week study suggest that PS-Omega3 may reduce ADHD symptoms in children. Preliminary analysis suggests that this treatment may be especially effective in a subgroup of hyperactive-impulsive, emotionally and behaviorally-dysregulated ADHD children. Keywords: Phosphatidylserine (PS); Omega3; ADHD; Docosahexaenoic acid (DHA); Eicosapentaenoic acid (EPA).

5. Improvement in learning and behaviour in children with learning difficulties and ADHD symptoms

Citation: Catherine M. Milte, Natalie Parletta, Jonathan D. Buckley, Alison M. Coates, Ross M. Young, Peter R.C. Howe, Eicosapentaenoic and docosahexaenoic acids, cognition, and behavior in children with attention-deficit/hyperactivity disorder: A randomized controlled trial, Nutrition, Volume 28, Issue 6, June 2012, Pages 670-677, ISSN 0899-9007, http://dx.doi.org/10.1016/j.nut.2011.12.009.(http://www.sciencedirect.com/science/article/pii/S0899900712000020)

Abstract: Objective To determine the effects of an eicosapentaenoic acid (EPA)–rich oil and a docosahexaenoic acid (DHA)–rich oil versus an ω-6 polyunsaturated fatty acid–rich safflower oil (control) on literacy and behavior in children with attention-deficit/hyperactivity disorder (ADHD) in a randomized controlled trial.

Methods: Supplements rich in EPA, DHA, or safflower oil were randomly allocated for 4 mo to 90 Australian children 7 to 12 y old with ADHD symptoms higher than the 90th percentile on the Conners Rating Scales. The effect of supplementation on cognition, literacy, and parent-rated behavior was assessed by linear mixed modeling. Pearson correlations determined associations between the changes in outcome measurements and the erythrocyte fatty acid content (percentage of total) from baseline to 4 mo.

Results: There were no significant differences between the supplement groups in the primary outcomes after 4 mo. However, the erythrocyte fatty acid profiles indicated that an increased proportion of DHA was associated with improved word reading ($r = 0.394$) and lower parent ratings of oppositional behavior ($r = 0.392$). These effects were more evident in a subgroup of 17 children with learning difficulties: an increased erythrocyte DHA was associated with improved word reading ($r = 0.683$), improved spelling ($r = 0.556$), an improved ability to divide attention ($r = 0.676$), and lower parent ratings of oppositional behavior ($r = 0.777$), hyperactivity ($r = 0.702$), restlessness ($r = 0.705$), and overall ADHD symptoms ($r = 0.665$).

Conclusion: Increases in erythrocyte ω-3 polyunsaturated fatty acids, specifically DHA, may improve literacy and behavior in children with ADHD. The greatest benefit may be observed in children who have comorbid learning difficulties. Keywords: Attention-deficit/hyperactivity disorder; Children; Learning difficulties; ω-3 Fatty acids; Docosahexaenoic acid; Eicosapentaenoic acid

New Zealand Research

Omega 3 is associated with adolescents' well-being.

Citation. Crowe, F. L., Skeaff, C. M., Green, T. J., & Gray, A. R. (2007). Serum phospholipid n− 3 long-chain polyunsaturated fatty acids and physical and mental health in a population-based survey of New Zealand adolescents and adults. *The American journal of clinical nutrition*, *86*(5), 1278-1285.

Abstract. Background: Evidence from observational studies suggests that there is an association betweenn 3long-chainpolyunsaturated fatty acids and depression; however, this association has yet to be examined in a population-based study.

Objective: The objective was to assess whether n3 long-chain polyunsaturated fatty acids in serum phospholipids are associated with mental and physical well-being.

Design: The fatty acid composition of serum phospholipids was measured in 2416 New Zealanders aged 15 y who took part in the 1997 National Nutrition Survey. The mental and physical component scores were assessed by using the short-form 36 health ques-

tionnaire.

Results: After adjustment for a number of covariates, there was a significant positive trend in self-reported physical well-being across the quintiles of eicosapentaenoic acid (P for trend 0.009) and the ratio of eicosapentaenoic to arachidonic acid (P for trend 0.012). The differences in the physical component score between the first and fifth quintiles were 2.4 and 2.5 points, respectively. The results showed that neither the proportion of eicosapentaenoic

acid nor that of docosahexaenoic acid was associated with the mental component score; however, there was a significant positive trend in mental well-being across the quintiles of the ratio of eicosapentaenoic to arachidonic acid (P for trend 0.044).

Conclusion: The results from this population-based survey of New Zealanders suggest a strong and consistent association between ei- cosapentaenoic acid in serum phospholipids and self-reported physical well-being; the association with mental well-being is less compelling. Am J Clin Nutr 2007;86:1278–85

Additional Stress Affecting Māori.

Citation. Sachdev, P. S. (1990). Behavioural factors affecting physical health of the New Zealand Maori. *Social Science & Medicine*, *30*(4), 431-440.

Abstract. A major factor in the aetiology of illness is the behaviour of individuals with regard to certain risks and hazards of the environment. The Maori of New Zealand have been shown to be at greater risk of illness and death than their non-Maori counterparts. It is estimated that a significant proportion of this excess morbidity and mortality can be attributed to at least four behavioural factors: smoking, obesity, alcohol use and accidents. This paper examines the inter-cultural differences in these factors, both from a contemporary and an historical perspective. Some of the reasons for the continuation of these adverse patterns of behaviour are explored, in particular the role of psycho-cultural stress. Some possible mechanisms of effecting behavioural change in modern Maori society are discussed.

Cultural considerations of fish -omega-3 and Potential Cultural Acceptability for Māori

Citation: Reis,C., & Hibbeln,J. (2006). Cultural symbolism of fish and the psychotropic properties of omega-3 fatty acids, *Prostaglandins, Leukotrienes and Essential Fatty Acids*, *75* (4–5), 227-236, ISSN 0952-3278, ISSN 0952-3278, http://dx.doi.org/10.1016/j.plefa.2006.07.014.(http://www.sciencedirect.com/science/article/pii/S0952327806001220)

Abstract: Fish is a food with unique psychotropic properties. Consumption of long-chain Omega-3 fatty acids, rich in seafood, reduces depression, aggression and anger while improving mental well-being. We posit that symbols of fish have become linked to the emotional states induced by long-chain fatty acid by associative pairings, both conscious and unconscious. The limbic and hippocampal activity necessary for memory formation containing emotional content and the labeling of social context by cortical processes appears to be optimized by diets rich in long-chain Omega-3 fatty acid. In this critical literature survey, we find that fish have been culturally labeled as symbols of emotional well-being and social healing in religious and medical practices among independent cultures, for at least six millennia. This understanding of the perception of fish as a symbolically healing or purifying food can assist current messages improving public health.

Maori traditionally ate Toheroa (paphies ventricosa), which is high in Omega-3, and many other seafoods as a staple of their customary diet, but dietary changes in the 20th century, and the apparent collapse of some seafood habitats seem to have reduced fish and shellfish consumption and may have resulted in Omega-3 deficiencies. (http://www.seafriends.org.nz/indepth/shellfish_collapse.htm - big_picture).

Mixed Effects of Omega 3 Supplementation Given at School

Citation. Lee, K. M. (2013). Investigating the effects of long chain omega-3 fatty acids on primary school achievement. *PhD Thesis, Massey University at Albany*.

Abstract. A RCT conducted in NZ for a PhD, with the aim to test effects of Omega-3 on academic tasks. This study also measured behaviour. The Omega-3 was administered at school and compared with a placebo control group. Unfortunately, the trial period of 15 weeks was interrupted by two weeks of no Omega-3 during the school holidays. It is interesting that teachers reported improvements in both groups – indicating that improving behaviour of some pupils may improve the classroom as a whole. It also may indicate that the teachers changed their behaviour toward the pupils because the 'cause' of the problem was no longer situated in their teaching or the parenting of the children, and thus perceived improvement in the children may be due to their different perceptions.

Comment: effects were limited possibly because children did not take Omega 3 on weekends or during school holidays.

Appendix 3:
Additional Strategy References and Abstracts

Teacher Stress

Ferguson, K., Frost, L., & Hall, D. (2012). Predicting teacher anxiety, depression, and job satisfaction. *Journal of Teaching and Learning*, *8*(1), 27-42.

Friedman-Krauss, A. H., Raver, C. C., Morris, P. A., & Jones, S. M. (2014). The role of classroom-level child behavior problems in predicting preschool teacher stress and classroom emotional climate. *Early Education and Development*, *25*(4), 530-552.

Grayson, J. L., & Alvarez, H. K. (2008). School climate factors relating to teacher burnout: A mediator model. *Teaching and Teacher Education*, *24*(5), 1349-1363.

Roeser, R. W., Schonert-Reichl, K. A., Jha, A., Cullen, M., Wallace, L., Wilensky, R., ... & Harrison, J. (2013). Mindfulness training and reductions in teacher stress and burnout: Results from two randomized, waitlist-control field trials. *Journal of Educational Psychology*, *105*(3), 787.

Wylie, C., & Hodgen, E. (2005). Stress and well-being among New Zealand principals: Report to the New Zealand Principals' Federation. *NZCER* 3, http://www.nzcer.org.nz/research/publications/stress-and-well-being-among-new-zealand-principals-report-new-zealand-principa?cPath=130_131&products_id=1555

Classroom Decor

Fisher, A. V., Godwin, K. E., & Seltman, H. (2014). Visual Environment, Attention Allocation, and Learning in Young Children When Too Much of a Good Thing May Be Bad. *Psychological Science*, *25*(7), 1362-1370.

Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2015). The impact of classroom design on pupils' learning: Final results of a holistic, multi-level analysis. *Building and Environment*, *89*, 118-133.

Brooker, A., & Franklin, A. (2016). The effect of colour on children's cognitive performance. *British Journal of Educational Psychology*, *86*(2), 241-255.

Elliot, A. J., & Maier, M. A. (2012). Color-in-context theory. *Advances in Experimental Social Psychology*, *45*, 61-125.

Jacobs, K. W., & Hustmeyer Jr., F. E. (1974). Effects of four psychological primary colors on GSR, heart rate and respiration rate. *Perceptual and Motor Skills*, *38*(3), 763-766;

Jacobs, K. W., & Suess, J. F. (1975). Effects of four psychological primary colors on anxiety state. *Perceptual and Motor Skills*, *41*(1), 207-210.

Küller, R., Mikellides, B., & Janssens, J. (2009). Color, arousal, and performance—A comparison of three experiments. *Color Research & Application*, *34*(2), 141-152.

Raanaas, R. K., Evensen, K. H., Rich, D., Sjøstrøm, G., & Patil, G. (2011). Benefits of indoor plants on attention capacity in an office setting. *Journal of Environmental Psychology*, *31*(1), 99-105.

Pale blue light: http://www.makegreatlight.com/blog/can-classroom-lighting-help-keep-students-alert

Noise

Ministry of Education desired sound level for a primary classroom, p. 57; 40dB for open plan classrooms. MoED: http://www.education.govt.nz/assets/Documents/Primary-Secondary/Property/School-property-design/Flexible-learning-spaces/AcousticsGuide.pdf

Angelillo, I. F., Di Maio, G., Costa, G., & Barillari, U. (2015). Prevalence of occupational voice disorders in teachers. *Journal of Preventive Medicine and Hygiene*, *50*(1), 26-32.

Davey, B., Alexander, M., Edmonson, C., Stenhoff, D., & West, R. P. (2001). The Effects of a Discriminative Stimulus, Paired with Individual and Group Reward Contingencies, on the Decibel Levels in an Elementary School Lunch Room. ERIC http://files.eric.ed.gov/fulltext/ED453023.pdf

Fuller, M. K. (2011). Noisy zones of proximal development: Conversation in noisy classrooms. *Journal of Sociolinguistics*, *15*(1), 65-93

Kinnealey, M., Pfeiffer, B., Miller, J., Roan, C., Shoener, R., & Ellner, M. L. (2012). Effect of classroom modification on attention and engagement of students with autism or dyspraxia. *American Journal of Occupational Therapy*, *66*(5), 511-519. (sound-absorbing walls & halogen lights, measured dB).

Maxwell, L. E., & Evans, G. W. (2000). The effects of noise on pre-school children's pre-reading skills. *Journal of Environmental Psychology, 20*(1), 91-97.

Mealings, K. T., Buchholz, J. M., Demuth, K., & Dillon, H. (2015). Investigating the acoustics of a sample of open plan and enclosed Kindergarten classrooms in Australia. *Applied Acoustics*, *100*, 95-105.

Ring, B. M., Sigurdsson, S. O., Eubanks, S. L., & Silverman, K. (2014). Reduction of classroom noise levels using group contingencies. *Journal of applied behavior analysis*, *47*(4), 840-844.

Classroom Light

A simple App can be downloaded from an App store and used to check light levels in the classroom. This would be a fun activity for children during math.

Example of Light Meter App. Retrieved from: https://appadvice.com/app/light-meter-hd-lux-measurement-tool/691138078

Lux levels needed for reading, writing and tasks at desk, and for listening to teacher, 300 lux: http://lightinglab.fi/IEAAnnex45/publications/Technical_reports/lighting_in_schools.pdf

Including the Ministry of New Zealand, http://www.education.govt.nz/assets/Documents/Primary-Secondary/Property/School-property-design/Flexible-learning-spaces/BranzLightingDesignGuide.pdf

Lee, H. S., Kwon, S. Y., & Lim, J. H. (2016). A development of a lighting control system based on context-awareness for the improvement of learning efficiency in classroom. *Wireless Personal Communications*, *86*(1), 165-181.

Sleegers, P. J. C., Moolenaar, N. M., Galetzka, M., Pruyn, A., Sarroukh, B. E., & van der Zande, B. (2012).

Abstract. Lighting affects students' concentration positively: findings from three Dutch studies. *Lighting Research and Technology*, 1477153512446099. These researchers compared concentration and performance errors during normal classroom lighting and when lux levels were 300. They found improvement in concentration after one month (Study 2) (d=2.19) in

children in year 4 in schools, compared to no change in a control classroom. (Temperature and Noise were in the desired range in both study classrooms). Sleegers study: Philips SmartForm luminaire fitted with a diffuser (TBS471 3xTL5 54 W 830 Electronic PC MLO). The average illumin ance at desk level was about 350lx with a CCT of 3000 K. Philips NZ 0800 454 448.

Light levels and other factors: Mott, M. S., Robinson, D. H., Walden, A., Burnette, J., & Rutherford, A. S. (2012). Illuminating the effects of dynamic lighting on student learning. *Sage Open*, 2158244012445585.

Focus lighting (1000lux at desk level) has been shown to improve reading of at risk students: Mott, M. S., Robinson, D. H., Williams-Black, T. H., & McClelland, S. S. (2014). The supporting effects of high luminous conditions on grade 3 oral reading fluency scores. *SPRINGERPLUS*, *3*:53.

Light levels are also thought to affect mood, in that brighter light is associated with increased serotonin and dopamine production. "Bright light therapy" has been shown to be effective for remission in adult depression in a meta-analysis d= .53 Golden, R. N., Gaynes, B. N., Ekstrom, R. D., Hamer, R. M., Jacobsen, F. M., Suppes, T., ... & Nemeroff, C. B. (2005). The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence. *American Journal of Psychiatry, 162,*656–662.

Temperature

Winter standards: 20 and 24°C (68–75°F), and summer standards: 23 and 26°C (73–79°F) with adequate ventilation (not measured in our observations). Haverinen-Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of classroom ventilation rate and temperature on students' test scores. *PloS one*, *10*(8), e0136165.

de Dear, R., Kim, J., Candido, C., & Deuble, M. (2015). Adaptive thermal comfort in Australian school classrooms. *Building Research & Information*, *43*(3), 383-398.

Gaihre, S., Semple, S., Miller, J., Fielding, S., & Turner, S. (2014). Classroom carbon dioxide concentration, school attendance, and educational attainment. *Journal of school health*, *84*(9), 569-574.

PPTA standards, health and safety for children and teachers: http://www.ppta.org.nz/resources/publication-list/2175-temperature-health-safety. Minimum, 10°C (laugh)-; 16-24°C.

Too hot might increase irritable behaviours and aggression: Graetz, K. A., & Goliber, M. J. (2002). Designing collaborative learning places: Psychological foundations and new frontiers. *New Directions for Teaching and Learning*, *2002*(92), 13-22. Each decrease in temperature by 1°Cwithin range of 20-25°C improved test scores in math by 12-13 points (ES=.67)

Play-Eat-Learn

Please note: "Play, Eat, Learn", is a name I dreamed up. In the USA, this is called "Recess Before Lunch", and the term 'recess' is not used in New Zealand, but the term "playtime' is – hence, Play-Eat-Learn.

Bark, K., Stenberg, S., & Hayes, D. (2010). Scheduling Recess Before Lunch: Exploring the Benefits and Challenges in Montana Schools. *Journal of Child Nutrition and Manage*ment. 34 (2).

Bhatt, R. (2009). The impact of school lunch length on children's health. Working paper 2009-4-2. Georgia State Univerisity: Andrew Young School.

Bhatt, R. (2014). Timing is Everything: The Impact of School Lunch Length on Children's Body Wei*ght. Southern Economic Jo*urna*l*, 80(3), 656-676.

Bounds, W., Nettles, M. F., & Johnson, J. T. (2009). Recess before Lunch Programs in Elementary Schools: Perceptions and Practices of School Professionals. *Journal of Child Nutrition & Mana*geme*n*t, 33(1), n1.

Getlinger, M. J., Laughlin, C. V., Bell, E., Akre, C., & Arjmandi, B. H. (1996). Food waste is reduced when elementary-school children have recess before lunch. *Journal of the American Dietetic Association*, *96*(9), 906-908.

Hunsberger, M., McGinnis, P., Smith, J., Beamer, B. A., & O'Malley, J. (2014). Elementary school children's recess schedule and dietary intake at lunch: a community-based participatory research partnership pilot study. *BMC Public Healt*h, *14*(1), 156.

Price, J., & Just, D. R. (2015). Lunch, recess and nutrition: Responding to time incentives in the cafeteria. *Preventive Medicine, 71,* 27-30.

Rainville, A. J., Wolf, K. N., & Carr, D. H. (2006). Recess placement prior to lunch in elementary schools: what are the barriers. *Journal of Child Nutrition & Management, 30,* (2), n.p.

Ramstetter, C. L., Murray, R., & Garner, A. S. (2010). The crucial role of recess in sc*hools. Journal of School Health*, *80*(11), 517-526.

Tanaka, C., Richards, K. L., Takeuchi, L. S., Otani, M., & Maddock, J. (2005). Modifying the recess before lunch program: a pilot study in Kaneohe elementary schoo*l. California Journal of Health Promotion, 3*(4), 1-7.

Breakfast

Benton, D. (2008). The influence of children's diet on their cognition and behavior. *European Journal of Nutrition*, *47*(3), 25-37.

Micha, R., Rogers, P. J., & Nelson, M. (2010). The glycaemic potency of breakfast and cognitive function in school children. *European journal of clinical nutrition*, *64*(9), 948-957.

Arnold, L. E., Hurt, E., & Lofthouse, N. (2013). Attention-deficit/hyperactivity disorder: dietary and nutritional treatments. *Child and adolescent psychiatric clinics of North America*, *22*(3), 381-402.

Adolphus, K., Lawton, C. L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Frontiers in Human Neuroscience*, *7*. http://gr2tq4rz9x.scholar.serialssolutions.com/?sid=google&auinit=K&aulast=Adolphus&atitle=The+effects+of+breakfast+on+behavior+and+academic+performance+in+children+and+adolescents&id=pmid:23964220

Duncan, J. S., Schofield, G., Duncan, E. K., & Rush, E. C. (2008). Risk factors for excess body fatness in New Zealand children. *Asia Pacific Journal of Clinical Nutrition*, *17*(1), 138-147.

Ingwersen, J., Defeyter, M. A., Kennedy, D. O., Wesnes, K. A., & Scholey, A. B. (2007). A low glycaemic index breakfast cereal preferentially prevents children's cognitive performance from declining throughout the morning. *Appetite*, *49*(1), 240-244.

Wesnes, K. A., Pincock, C., Richardson, D., Helm, G., & Hails, S. (2003). Breakfast reduces declines in attention and memory over the morning in schoolchildren. *Appetite*, *41*(3), 329-331.

Wesnes, K. A., Pincock, C., & Scholey, A. (2012). Breakfast is associated with enhanced cognitive function in schoolchildren. An internet based study. *Appetite*, *59*(3), 646-649.

Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J., & Metzl, J. D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *Journal of the American Dietetic Association*, *105*(5), 743-760.

Abstract. Breakfast has been labeled the most important meal of the day, but are there data to support this claim? We summarized the results of 47 studies examining the association of breakfast consumption with nutritional adequacy (nine studies), body weight (16 studies), and academic performance (22 studies) in children and adolescents. Breakfast skipping is highly prevalent in the United States and Europe (10% to 30%), depending on age group, population, and definition. Although the quality of breakfast was variable within and between studies, children who reported eating breakfast on a consistent basis tended to have superior nutritional profiles than their breakfast-skipping peers. Breakfast eaters generally consumed more daily calories yet were less likely to be overweight, although not all studies associated breakfast skipping with overweight. Evidence suggests that breakfast consumption may improve cognitive function related to memory, test grades, and school attendance. Breakfast as part of a healthful diet and lifestyle can positively impact children's health and well-being. Parents should be encouraged to provide breakfast for their children or explore the availability of a school breakfast program. We advocate consumption of a healthful breakfast on a daily basis consisting of a variety of foods, especially high-fiber and nutrient-rich whole grains, fruits, and dairy products.

Drink to Think

D'Anci, K. E., Constant, F., & Rosenberg, I. H. (2006). Hydration and cognitive function in children. *Nutrition Reviews*, *64*(10), 457-464.

"*Abstract***.** Adequate fluid intake is critical for survival. While adults are at liberty to drink fluids as wanted, children and infants are dependent upon caregivers for food and fluid. Children are at greater risk for dehydration than adults due to their higher surface-to-mass ratio. Additionally, children have different thirst sensitivities and body cooling mechanisms than adults. Children differ from adults in total body water content, and boys and girls differ in body water content with maturation. Research in young adults shows that mild dehydration corresponding to only 1% to 2% of body weight loss can lead to significant impairment in

cognitive function. Dehydration in infants is associated with confusion, irritability, and lethargy; in children, it may produce decrements in cognitive performance.”

Studies About Dehydration

Bar-David, Y. A. I. R.,Urkin, J., & Kozminsky, E. L. Y. (2005). The effect of voluntary dehydration on cognitive functions of elementary school children. *Acta Paediatrica, 94*(11), 1667-1673.

Kempton, M. J., Ettinger, U., Foster, R., Williams, S. C., Calvert, G. A., Hampshire, A., ... & Smith, M. S. (2011). Dehydration affects brain structure and function in healthy adolescents. *Human Brain Mapping*, *32*(1), 71-79.

Kenney, E. L., Long, M. W., Cradock, A. L., & Gortmaker, S. L. (2015). Prevalence of inadequate hydration among US children and disparities by gender and race/ethnicity: National Health and Nutrition Examination Survey, 2009–2012. *American journal of public health*, *105*(8), e113-e118

Moore, R. (2017). *EAT5 Drinks-An investigation into the drink intake of five-year old children living in New Zealand* (Doctoral dissertation, University of Otago).

Turnbull, G. J. (2006). The biology of post-traumatic stress disorder. *Psychiatry*, *5*(7), 221-224

Studies About the Effect of Drinking Water as Related to Learning

D’Anci, K. E., Constant, F., & Rosenberg, I. H. (2006). Hydration and cognitive function in children. *Nutrition Reviews*, *64*(10), 457-464.

Khan, N. A., Raine, L. B., Drollette, E. S., Scudder, M. R., Cohen, N. J., Kramer, A. F., & Hillman, C. H. (2015). The relationship between total water intake and cognitive control among prepubertal children. *Annals of Nutrition and Metabolism*, *66* (Suppl. 3), 38-41.

Benton, D., & Burgess, N. (2009). The effect of the consumption of water on the memory and attention of children. *Appetite*, *53*(1), 143-146.

Edmonds, C. J., & Jeffes, B. (2009). Does having a drink help you think? 6–7-Year-old children show improvements in cognitive performance from baseline to test after having a drink of water. *Appetite*, *53*(3), 469-472.

Fadda, R., Rapinett, G., Grathwohl, D., Parisi, M., Fanari, R., Calò, C. M., & Schmitt, J. (2012). Effects of drinking supplementary water at school on cognitive performance in children. *Appetite*, *59*(3), 730-737

Masento, N. A., Golightly, M., Field, D. T., Butler, L. T., & van Reekum, C. M. (2014). Effects of hydration status on cognitive performance and mood. *British Journal of Nutrition*, *111*(10), 1841-1852.

Fuchs, T., Lührmann, P., Simpson, F., & Dohnke, B. (2016). Fluid Intake and Cognitive Performance: Should Schoolchildren Drink During Lessons?. *Journal of School Health*, *86*(6), 407-413.

Gowin, J. (2010). Why your brain needs water. *Psychology Today.* https://www.psychologytoday.com/blog/you-illuminated/201010/why-your-brain-needs-water

Additional Considerations of Drinking Water in Schools

Ministry of Health (2015). Guidelines for fluid intake. From: *Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2-18 years): A background paper.* 72-84. Wellington: Ministry of Health.

Gibson□Moore, H. (2013). Improving hydration in children: a sensible guide. *Nutrition Bulletin*, *38*(2), 236-242.

Johnston Molloy, C., Gandy, J., Cunningham, C., & Glennon Slattery, C. (2008). An exploration of factors that influence the regular consumption of water by Irish primary school children. *Journal of Human Nutrition and Dietetics*, *21*(5), 512-515.

Wholemeal Snack

Benton, D., & Jarvis, M. (2007). The role of breakfast and a mid-morning snack on the ability of children to concentrate at school. *Physiology & Behavior*, *90*(2), 382-385.

The snack in this study was a museli bar provided free by Kellog Corporation. Nutritional information given for each bar: 35 g carbohydrate, 2.5 g protein and 1 g of fat.)

Micha, R., Rogers, P. J., & Nelson, M. (2010). The glycemic potency of breakfast and cognitive function in school children. *European Journal of Clinical Nutrition*, *64*(9), 948.

Abstract. Objectives: The aim of this study was to assess how the glycaemic potency (blood glucose (BG)-raising potential) of breakfast is associated with cognitive function (CF) in school children, taking into account important confounders, including iron status, underlying physiological adaptations and socio-economic status.

Methods: Sixty children aged 11–14 years were selected on the basis of having breakfast habitually. Their breakfast and any snacks eaten on the morning of the study were recorded. They were categorized into four groups according to the glycaemic index (GI) and glycaemic load (GL) of the breakfast: low-GI, high-GL; high-GI, high-GL; low-GI, low-GL and high-GI, low-GL above or below the median for GI¼ 61 and GL¼ 27. BG levels were measured in finger-prick blood samples immediately before and immediately after the CF tests.

Results: A low-GI, high-GL breakfast was associated with better performance on a speed of information processing ($P>0.01$) and a serial sevens ($P<0.001$) task 90min later; a high-GI breakfast with better performance on an immediate word recall task ($P<0.01$); and a high-GL breakfast with better performance on a Matrices task ($P<0.01$).

Conclusions: GI, GL or both were associated with performance on the majority of the CF tests (4 of 7) used. This study describes the macronutrient composition of breakfast that could have a positive influence on the cognition of school children, proposes the use of both GI and GL to estimate exposure, and discusses future directions in this area of research.

Micha, R., Rogers, P. J., & Nelson, M. (2011). Glycaemic index and glycaemic load of breakfast predict cognitive function and mood in school children: a randomised controlled trial. *British journal of nutrition*, *106*(10), 1552-1561.

Abstract. The macronutrient composition of a breakfast that could facilitate performance after an overnight fast remains unclear. As glucose is the brain's major energy source, the interest is in investigating meals differing in their blood glucose-raising potential. Findings vary due to unaccounted differences in glucoregulation, arousal and cortisol secretion. We investigated the effects of meals differing in glycaemic index (GI) and glycaemic load (GL) on cognition and mood in school children. A total of seventy-four school children were matched and randomly allocated either to the high-GL or low-GL group. Within each GL group, children received high-GI and low-GI breakfasts. Cognitive function (CF) and mood were measured 95 –140 min after breakfast. Blood glucose and salivary cortisol were measured at baseline, before and after the CF tests. Repeated-measures ANOVA was used to identify differences in CF, mood, glucose and cortisol levels between the breakfasts. Low-GI meals predicted feeling

more alert and happy, and less nervous and thirsty (P<0·05 for each); high-GL meals predicted feeling more confident, and less sluggish, hungry and thirsty (P<0·05 for each). High-GL (P<0·001) and high-GI (P≤0·05) meals increased glucose levels 90 min after breakfast, and high-GI meals increased cortisol levels (P<0·01). When base-line mood, glucose and cortisol levels were considered, low-GI meals predicted better declarative-verbal memory (P≤0·03), and high-GI meals better vigilance (P <0·03); observed GI effects were valid across GL groups. GI effects on cognition appear to be domain specific. On balance, it would appear that the low-GI high-GL breakfast may help to improve learning, and of potential value in informing government education policies relating to dietary recommendations and implementation concerning breakfast.

Smith, A. P., & Wilds, A. (2009). Effects of cereal bars for breakfast and mid-morning snacks on mood and memory. *International Journal of Food Sciences and Nutrition*, *60*(sup4), 63-69.

(Young adults aged 20 years).

Abstracts. The aim of the present study was to examine the effects of consuming cereal bars, given either for breakfast or a mid-morning snack, on mood and memory. Thirty-two volunteers (16 males, 16 females; mean age, 20 years 9 months) were randomly assigned to one of four groups formed by combining breakfast (cereal bar versus no breakfast) and snack (cereal bar versus no snack) conditions. A baseline session was completed at 08:30 h followed by breakfast at 9:00 h, another test at 10:00 h, followed by a mid-morning snack and then a final test at 12:00 h. In each session, volunteers rated their mood and carried out four memory tasks: free recall; recognition memory; a verbal reasoning task; and a semantic processing task. The results showed that volunteers who consumed a cereal bar for breakfast felt more alert, happy and sociable and less anxious. In addition, they also recalled more words in a free recall task. When the cereal bar was consumed as a mid-morning snack, alertness and hedonic tone increased, especially in the group who received no breakfast. The group who had no breakfast reported reduced anxiety after consumption of the snack. Recall was also improved after the snack. These findings show that consuming cereal bars in the early and mid-morning leads to beneficial behavioural effects. Alertness and hedonic tone in the late morning were increased by both breakfast and a mid-morning snack. The results confirm earlier research on effects of breakfast and extend our knowledge of effects of snacks. Consumption of cereal bars may have important practical applications especially in situations where preparation of breakfast is difficult.

Snack consisted of participants' choice of: Kellogg's Nutrigrain bars: Apple,Blueberry, Fruit/yoghurt or Strawberry; or Kellogg's Elevenses) and each bar provided 555/133 KJ/kcal, 25.5 g carbohydrate, 1.5 g protein, 2.96 g fat and between 0.75 and 1.11 g fibre.

Advice from Pediatrian for Children

Source: http://pediatrics.about.com/cs/agesstages/a/six_years.htm

"Your child's nutrition is important to his overall health. Proper nutrition, which should include eating three meals a day and two nutritious snacks, limiting high sugar and high fat foods, eating fruits, vegetables, lean meats and low fat dairy products, including 3 servings of milk, cheese or yogurt to meet their calcium needs can also prevent many medical problems,

including becoming overweight, developing weak bones, and developing diabetes. It will also ensure that your child physically grows to his full potential."

"You can also help promote good nutrition by setting a good example. Healthy eating habits and regular exercise should be a regular part of your family's life. It is much easier if everyone in the house follows these guidelines, than if your child has to do it alone. You should also buy low-calorie and low-fat meals, snacks and deserts, low fat or skim milk and diet drinks. Avoid buying high calorie deserts or snacks, such as snack chips, regular soft drinks or regular ice cream. "

Information about Diet and Mood

Source: http://www.calmclinic.com/anxiety/treatment/7-foods-that-fight-anxiety

"Healthy eating is one of the best ways to control anxiety and stress. In fact, one of the best things you can add to your diet is more water. Many studies have found that dehydration affects as many as 25% of those with persistent stress or more, and dehydration is known to cause more anxiety."

Snack and Obesity

Baum, P., Petroff, D., Classen, J., Kiess, W., & Blüher, S. (2013). Dysfunction of autonomic nervous system in childhood obesity: a cross-sectional study. *PloS one, 8*(1), e54546.

Bell, J. F., & Zimmerman, F. J. (2010). Shortened nighttime sleep duration in early life and subsequent childhood obesity. *Archives of Pediatrics & Adolescent Medicine, 164*(9), 840-845.

Dallman, M. F. (2010). Stress-induced obesity and the emotional nervous system. *Trends in Endocrinology & Metabolism, 21*(3), 159-165.

Fatima, Y., & Mamun, A. A. (2015). Longitudinal impact of sleep on overweight and obesity in children and adolescents: a systematic review and bias-adjusted meta-analysis. *Obesity Reviews, 16*(2), 137-149.

Jarrin, D. C., McGrath, J. J., & Drake, C. L. (2013). Beyond sleep duration: distinct sleep dimensions are associated with obesity in children and adolescents. *International Journal of Obesity, 37*(4), 552-558.

Pinto-Gouveia, J., & Matos, M. (2011). Can shame memories become a key to identity? The centrality of shame memories predicts psychopathology. *Applied Cognitive Psychology, 25*(2), 281-290.

Scharf, R. J., Demmer, R. T., & DeBoer, M. D. (2013). Longitudinal evaluation of milk type consumed and weight status in preschoolers. *Archives of Disease in Childhood, 98*(5), 335-340.

Sinha, R., & Jastreboff, A. M. (2013). Stress as a common risk factor for obesity and addiction. *Biological Psychiatry, 73*(9), 827-835.

Spruyt, K., Molfese, D. L., & Gozal, D. (2011). Sleep duration, sleep regularity, body weight, and metabolic homeostasis in school-aged children. *Pediatrics, 127*(2), e345-e352.

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Dr. Gaye Tyler-Merrick

Dr. Tracey Clelland

Dr. Karyn France

Raesha Ismail

Lawrence Walker

Lee Hooper

Tara Mueller

Tom van Laanen

Advisory Group

Angela Davies, Courtnay Sheat, Rata Foundation

Sue Bagshaw, Ria Schroeder, Collaborative Trust

Noeline Allan, Graham Dingle Foundation

Cherie Benns, Carolyn Doughty, Child and Family Specialty Service; Canterbury District Health Board

Benita Stiles-Smith, Clinical Psychologist and Nurse, Clinical supervisor, Massey University

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Parent Advisory Group Members (anonymous)

Dr. John Crawshaw and Dr. Colin Hamlin, Ministry of Health

Dr. Harish Swadi: Canterbury District Health Board

Liz McNaughton, Te Paeroa RTLB Cluster

Dr. Philip Pattemore, University of Otago School of Medicine and Canterbury Public Hospital

Dr. Jim Reid, University of Otago School of Medicine and Dean of General Practice

Teachers 2013-2016

Alice Gibb
Alice McGinty
Amanda Gray
Amanda McLean
Amber Donovan
Amy Buick
Andrea Swanson
Ann Edmundson
Anna Reid
Anna Smith
Barbara Byers
Bethan Philp
Bridget Arwin
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Sue Leadbetter
Susan Walsh
Tara Bigelow
Teresa Geal
Tessa Cooper
Vanessa Adams
Vicki Piper
Vicky Hishon

*The Principal and teachers of a school that wished to remain anonymous

Kathleen Liberty, Ph.D. is Associate Professor of Health Sciences, School of Health Sciences, College of Education, Health and Human Development at the University of Canterbury, Christchurch New Zealand. She received her Masters degree in Education from the University of Oregon, Eugene, Oregon (USA) and a Ph.D. from the University of Washington, Seattle, Washington (USA). She has lived in Christchurch, New Zealand since 1990, and throughout the earthquakes and post-earthquakes period. She may be contacted by email: kathleen.liberty@canterbury.ac.nz

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A neurobiological approach to school-based intervention for children with stress-related behaviours

A major strength of the approach described in this book is the innovative combination of evidence-informed strategies in schools to address the biological symptoms of post-traumatic stress of children who had experienced a very extended period of earthquakes, floods, and other disaster-related events.

In comparison with other approaches, the interventions do not rely on professional clinicians and do not require teachers to engage in additional teaching activities. The innovative strategies are suitable for all children in a primary school setting and require few additional resources.

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